Seasonal Climate Outlook for Winter 2020/2021 over China

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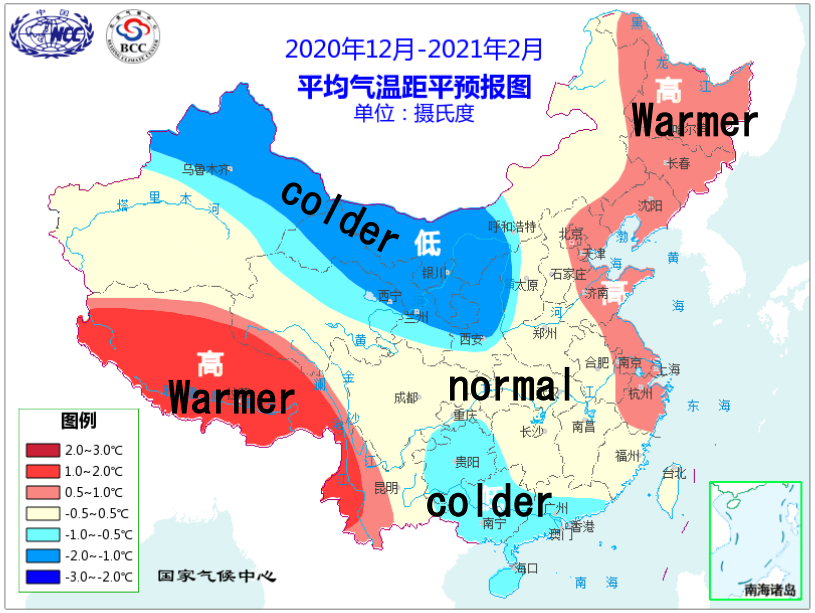
Beijing Climate Center, China Meteorological Administration

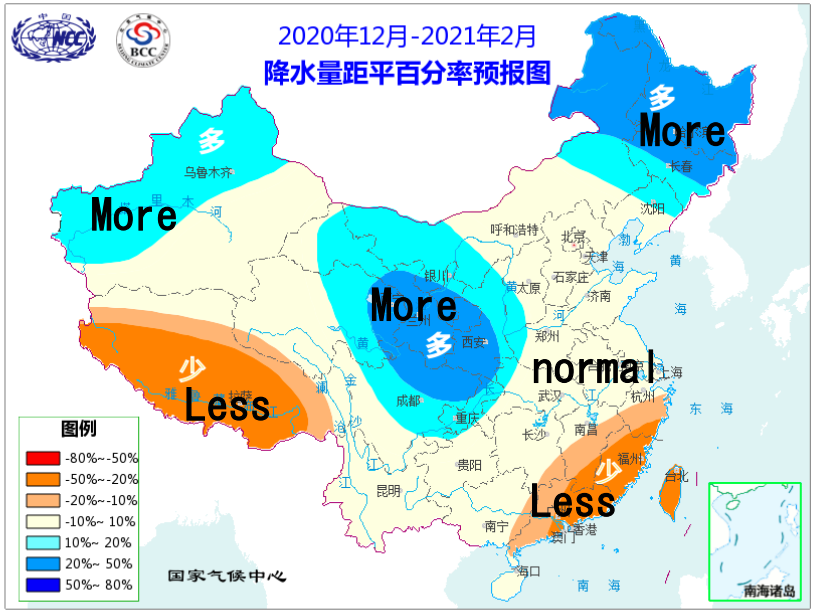
2020-11-05

Prediction of China Climate anomaly during winter 2020/2021

Anomalies of Air Temperature

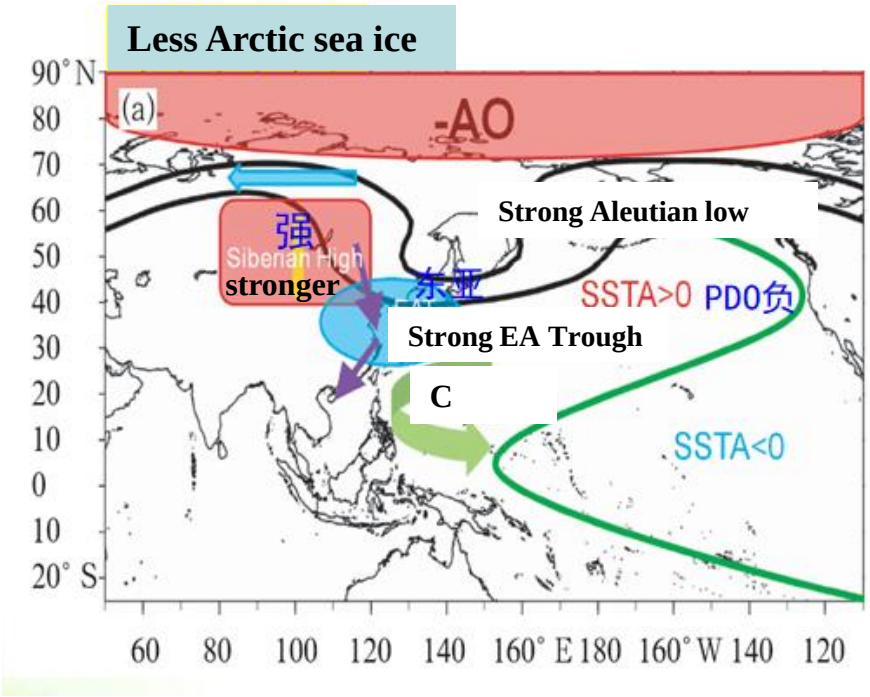


Anomalous percentages of precipitation

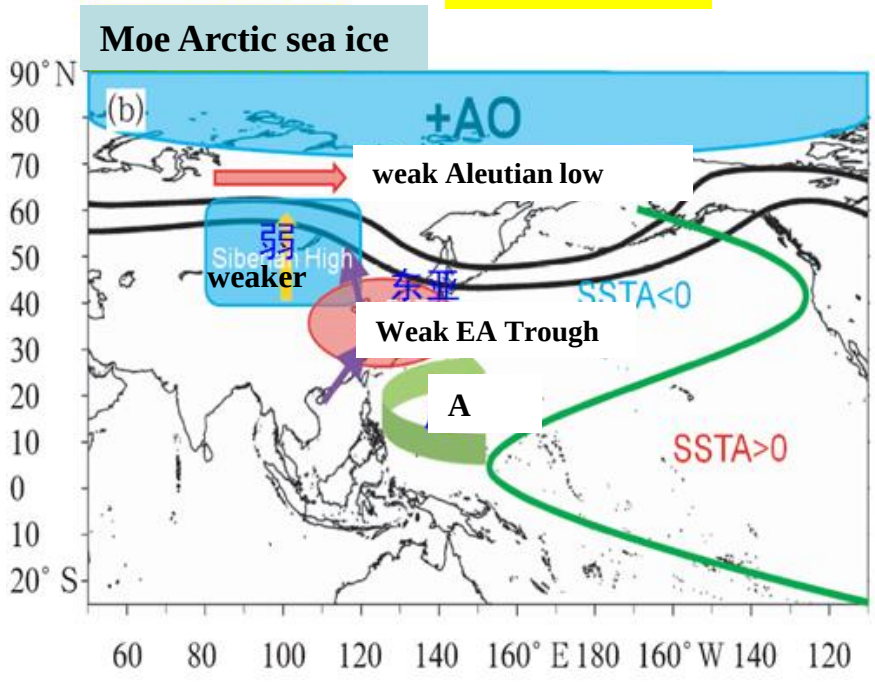


Climate Systems of Winter Cold（Warm） for China

Colder



Warmer



Liang Sujie et al. 2014；
Ding Yihui et al 2014;
Wu Bingyi,1999，2011，2018

content

- **Recent characteristics of external forcings**

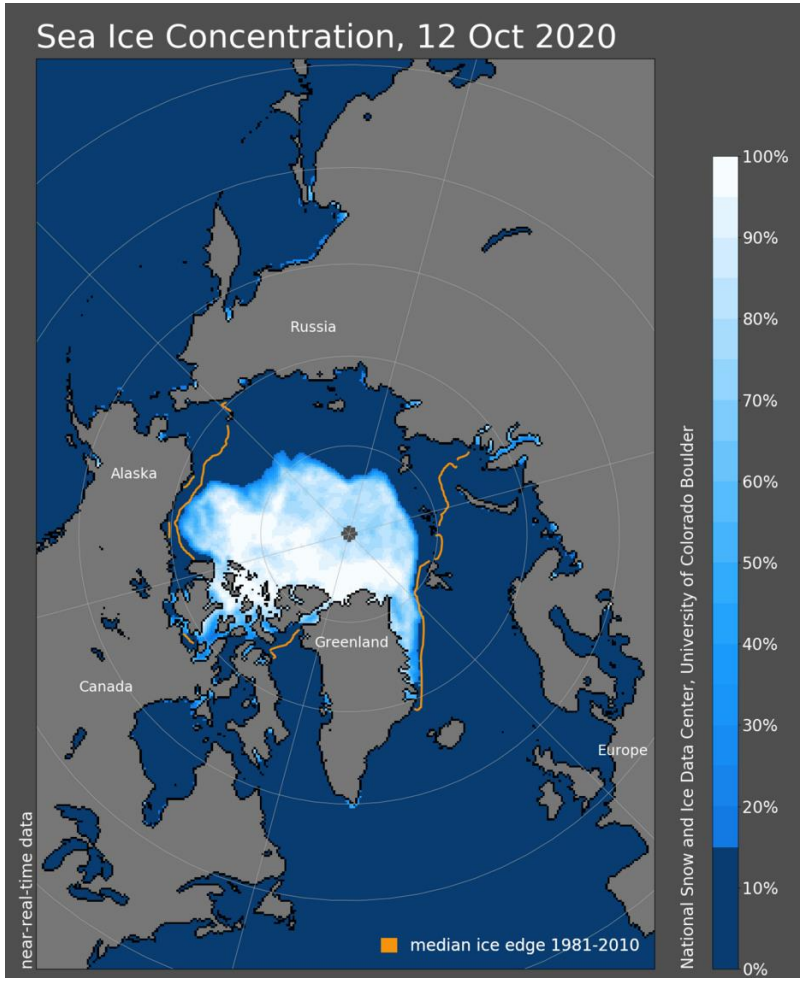
  Sea ice, SST

- **Outlook of China winter climate**

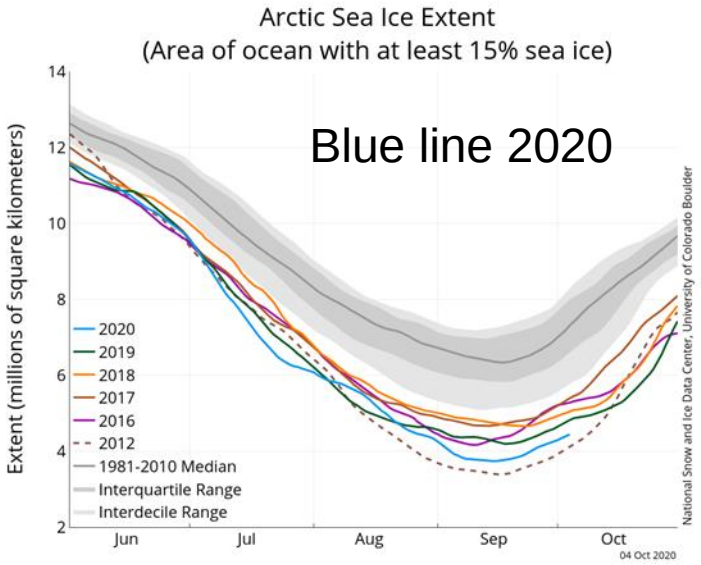
  Circulations, air temperature, precipitation, diagnoses

Recent Characteristic of Arctic Sea ice

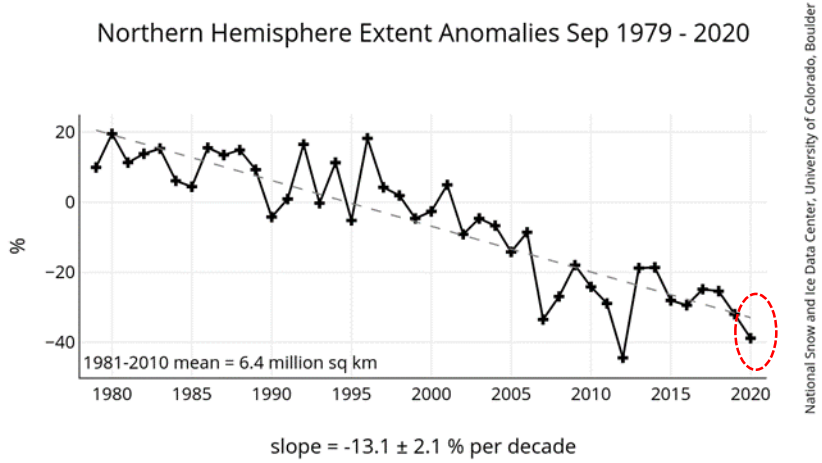
Recent Sea ice Concentration



Comparison of Sea Ice in recent years



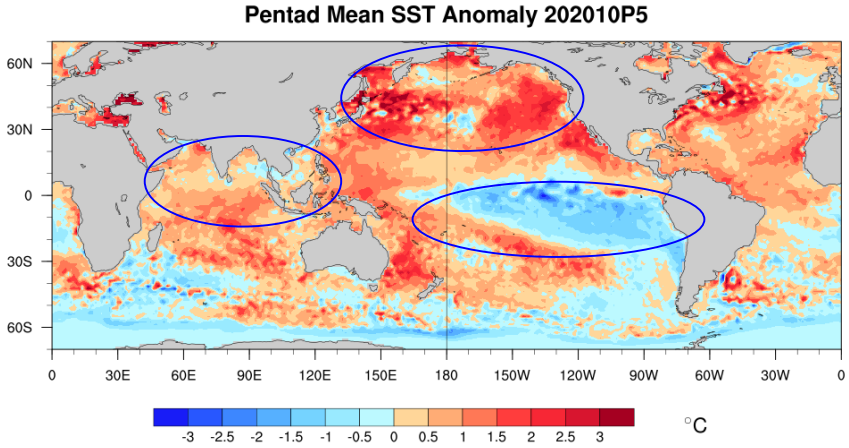
Evolution of yearly Sea ice in Sep

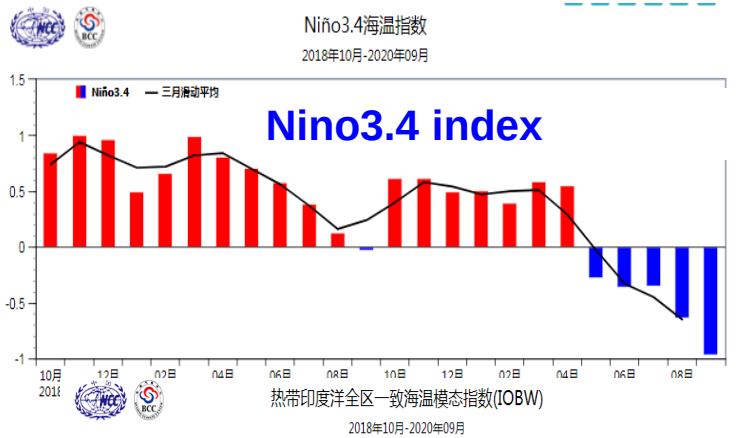


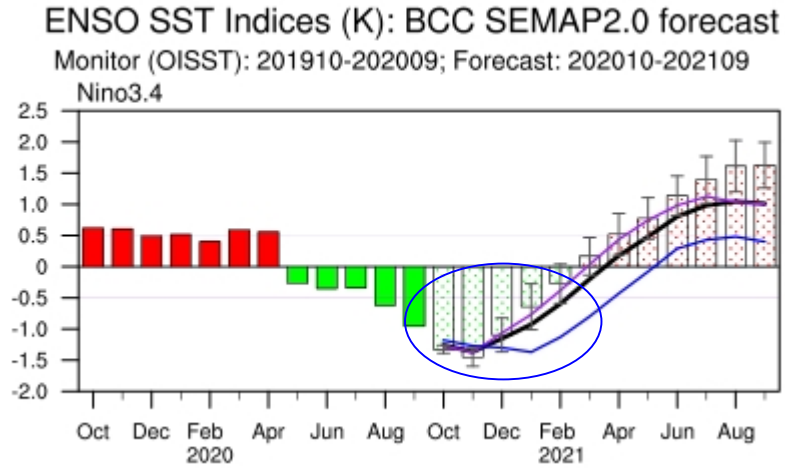
slope = -13.1 ± 2.1 % per decade

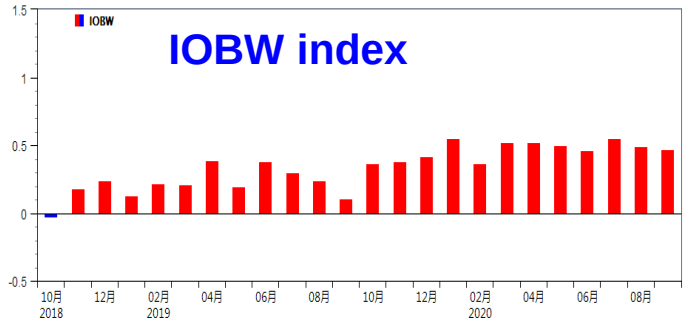
Recent Sea surface temperature(SST) anomalies

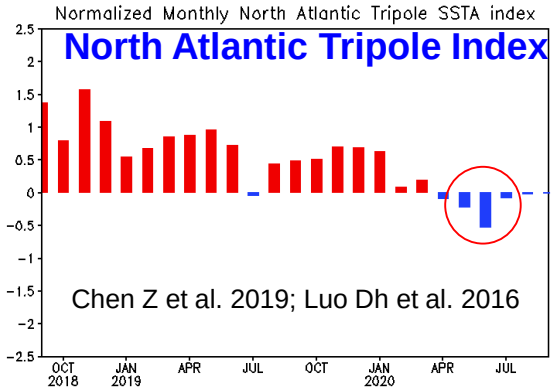
SST in the fifth pentad of OCT











BCC: weak to moderate La Niña event is expected during coming winter！

Climate Monitoring Division/NCC/CMA

content

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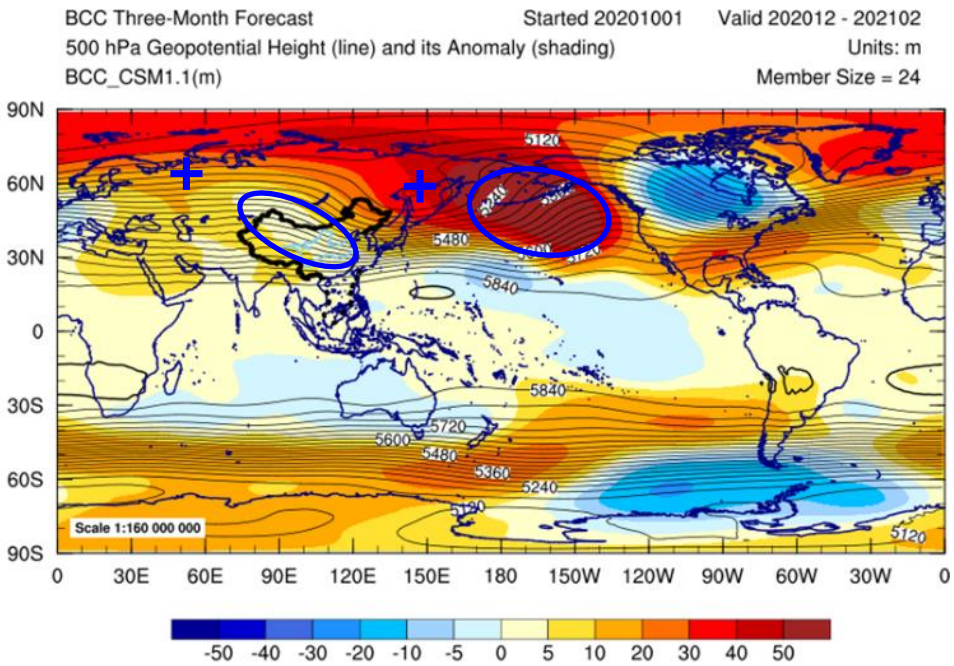
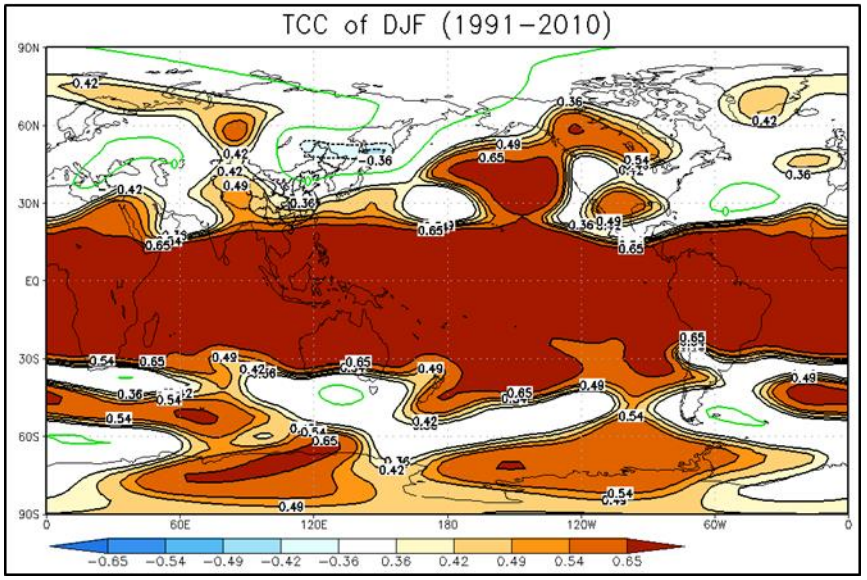
Circulation forecast for winter 2020/2021 by BCC model

BCC_CSM1.1m



Hindcast skill



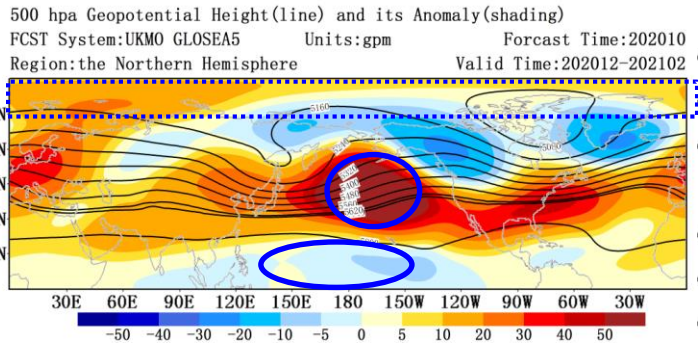
BCC_CSM1.1m winter forecast:

1) stronger Ural block high，2) lower height south of Lake Baikal,

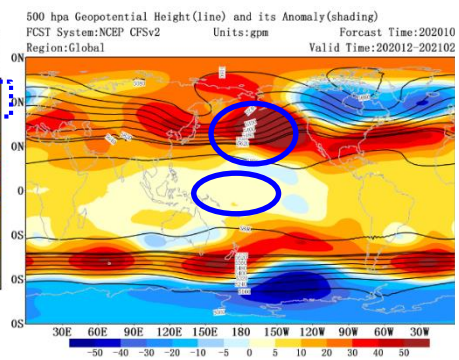
3) Negative phase of AO (lower skill), 4) higher height over the North Pacific and weaker subtropical High (responses to La Niña).

Circulation forecast for winter 2020/2021 by foreign models

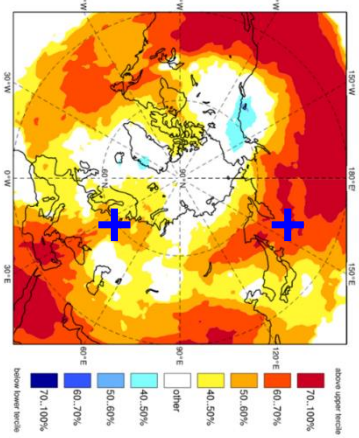
UKMO



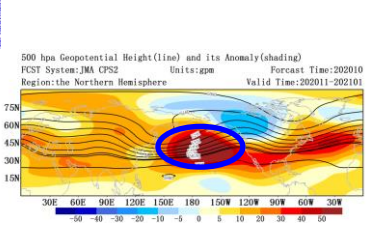
CFS V2



ECMWF5



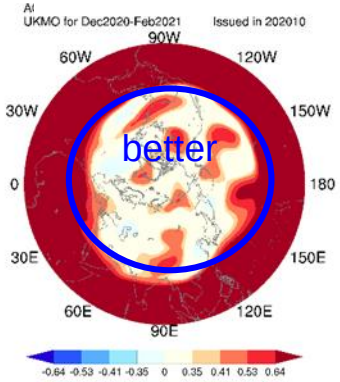
JMA



Validation

H500

UKMO



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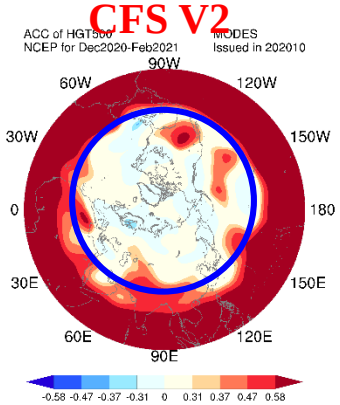
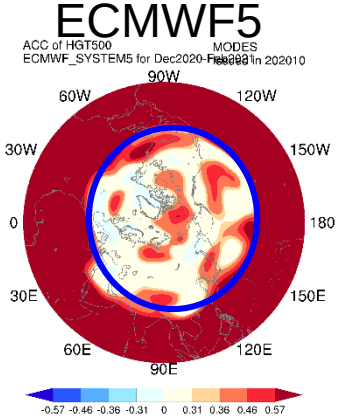


ECMWF5



Indices of East Asian winter monsoon

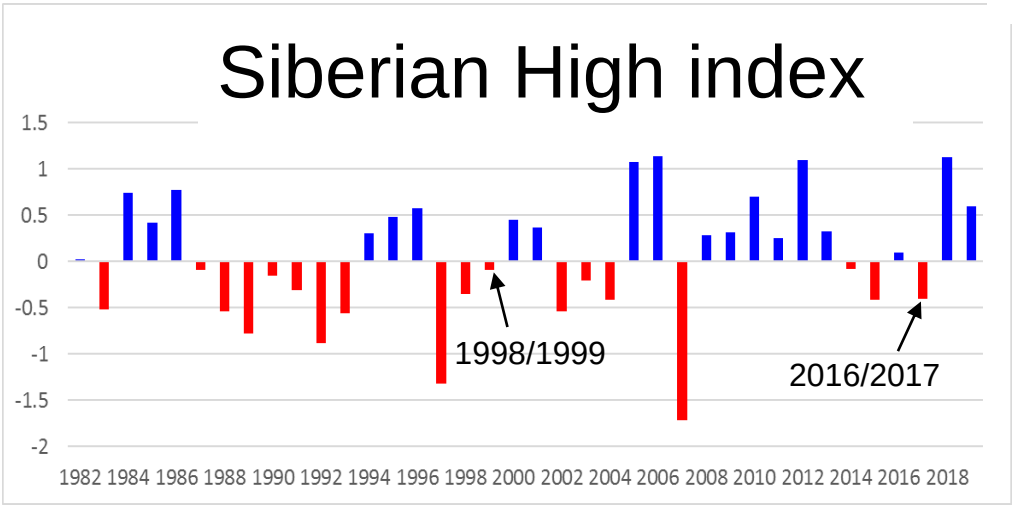
（All standardized）

- **Siberian High index** (SH, operational standard, 2010)
  SLP averaged in 40°~60°N, 80°~120°E

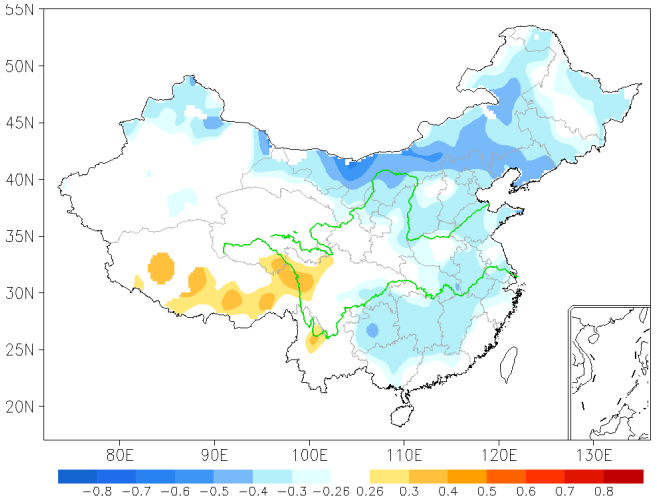
- **East Asian winter monsoon Index**（EAWM, Zhu Yanfeng，2008）
  EAWM =U500 (25°~35°N , 80°~120°E) —U500 (50°~60°N, 80°~120°E)

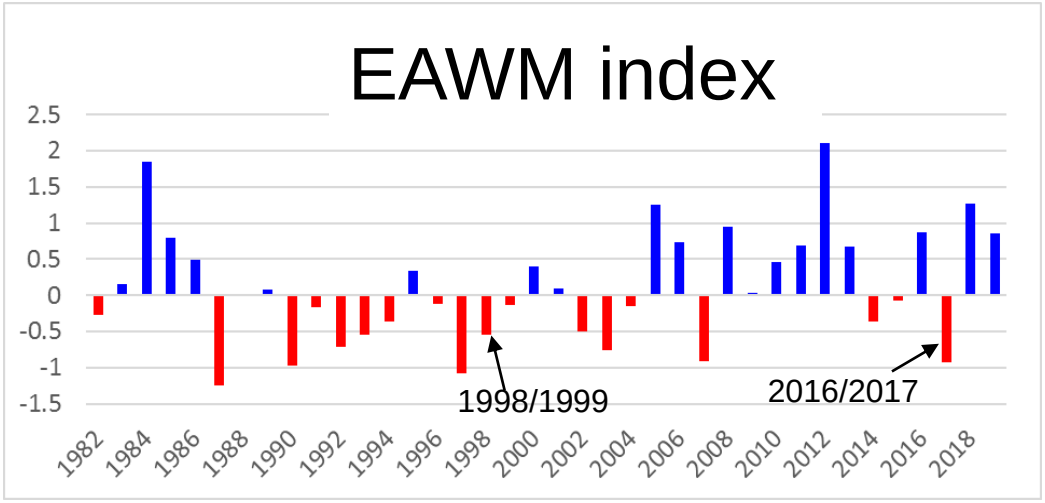
- **Tibetan High index** (TibetH, operation)
  500-hPa High averaged in 25°N-35°N, 80°E-100°E, with area weighted

Relationships of EAWM indices and China winter Temp

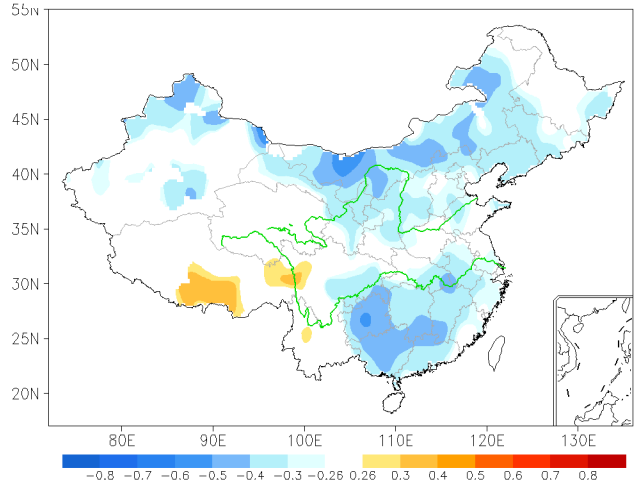


Correlations of SH index & Temp





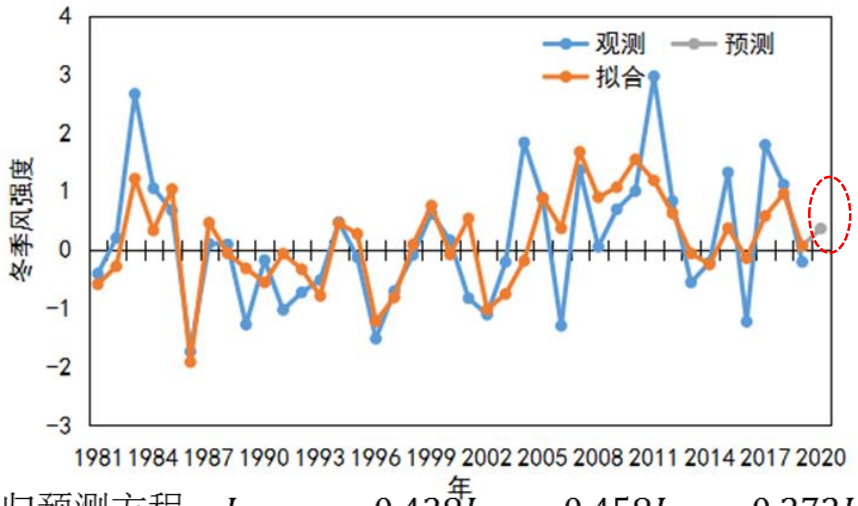
Correlations of EAWM & Temp



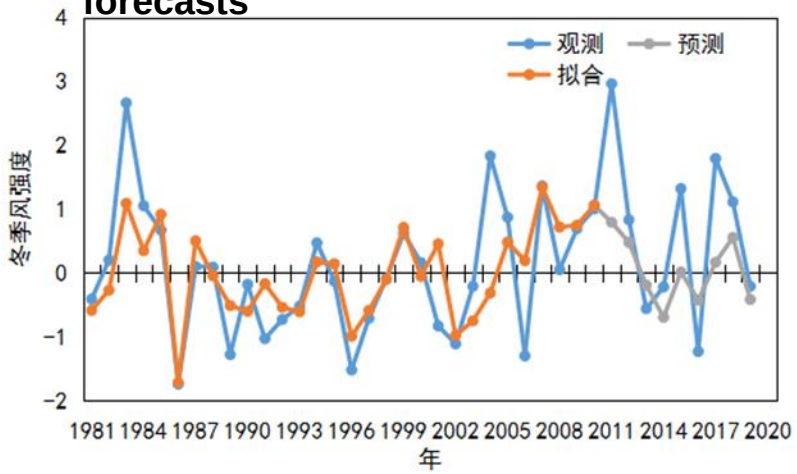
EAWM index prediction

---by statistical model

Forecast

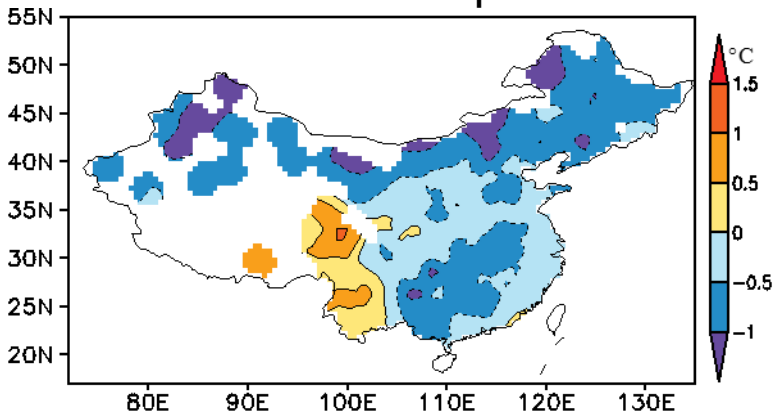


Cross-hindcast & independent sample forecasts



回归预测方程：$I_{EAWM} = 0.438I_{Air} - 0.458I_{Ice} - 0.272I_{SST} + 0.08$

Forecast Winter temp. 2020/2021



Predictors: 1) air temp., 2) Kara Sea Ice, and 3) northeastern Pacific SST all in Sep;

Predictand: EAWM index

Forecast value standardized in winter 2020/2021: 0.36

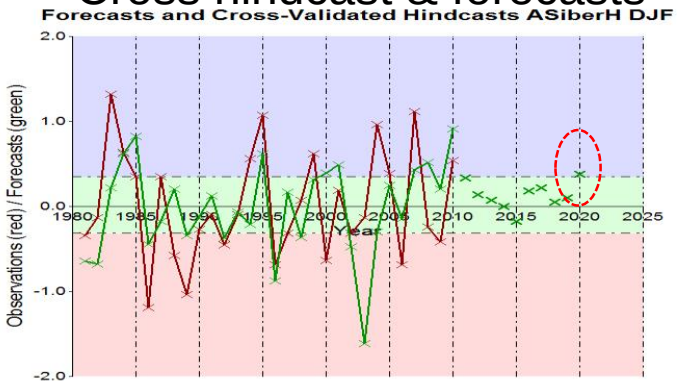
Liu Ke et al. (2013)

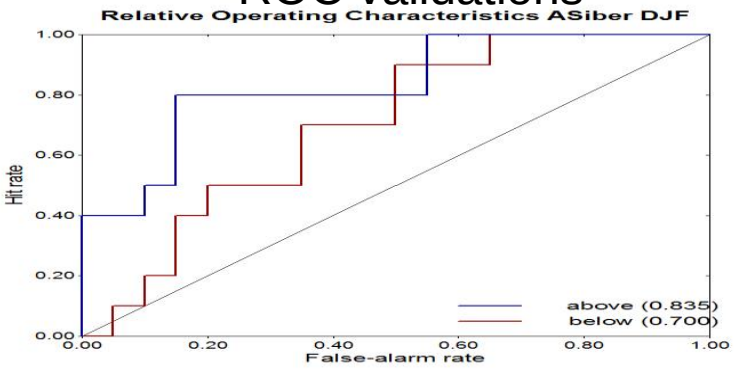
SH and TibetH indices prediction

Cross hindcast & forecasts

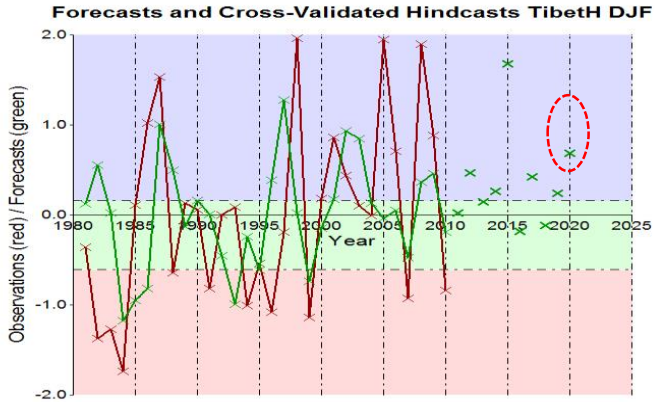
ROC validations

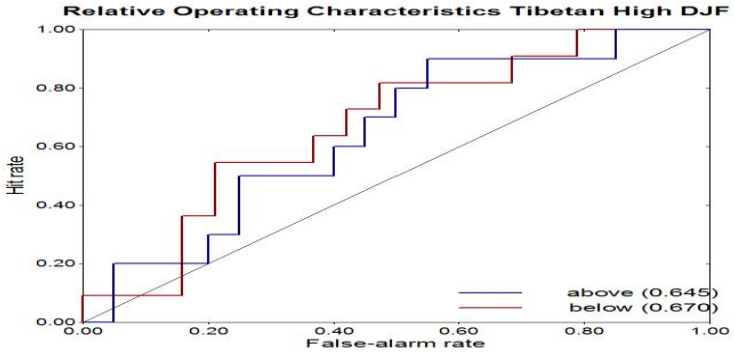
SH





TibetH





Predictors: 1) Barents Sea ice; 2) Kara Sea Ice; 3) Laptev-Beaufort Sea Ice; 4) Nino3.4 index; 5) IOBW index. All factors in preceding Sep;

Predictands: SH and TibetH indices

Forecast values standardized in winter 2020/2021: SH=0.38; TibetH=0.91

Summary of Winter circulation forecasts

- **Circulations over mid-high latitudes of Eurasia:**
  Meridional pattern dominating，stronger cold air influencing China；
- **EAWM：stronger**
- **Siberian High：stronger**
- **Ural block High：stronger**
- **Tibetan High：higher**
- **East Asian trough：normal-weak**
- **Subtropical WNP High：normal to weaker, eastward**
- **Low level over east of Philippine：anomaly cyclone**

content

- **Recent characteristics of external forcings**

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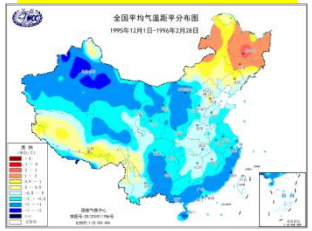
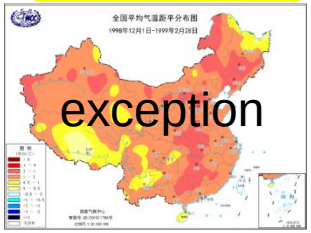
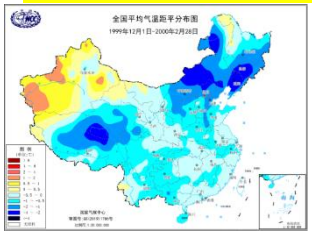
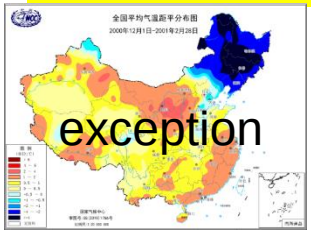
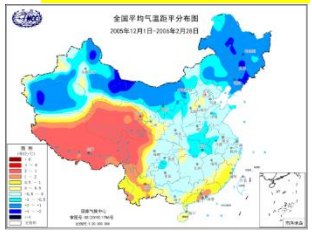
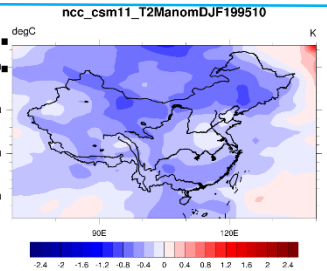
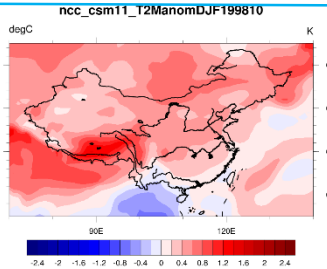
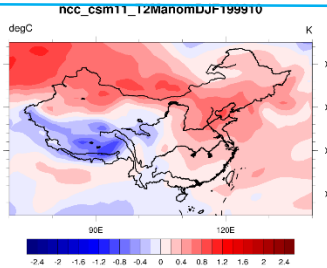
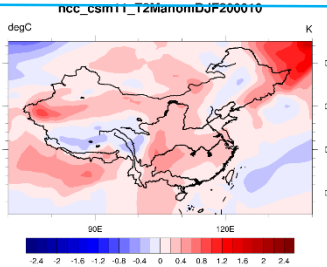
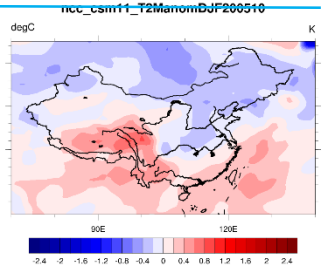
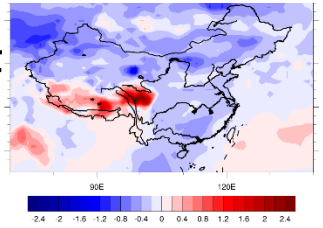
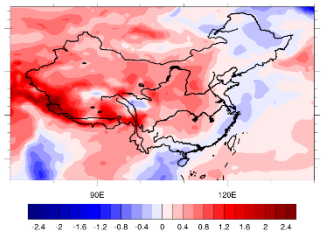
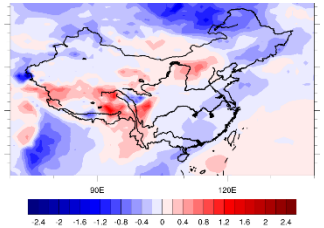
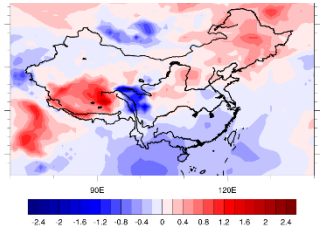
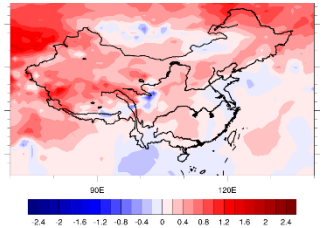
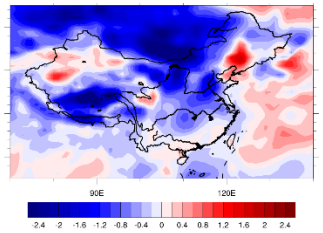
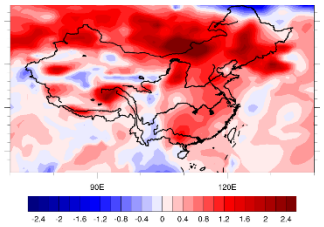
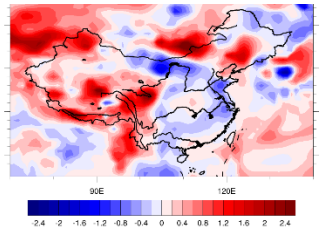
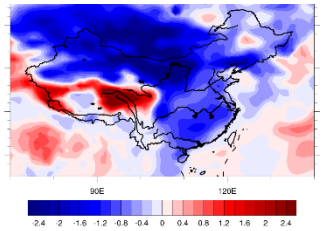
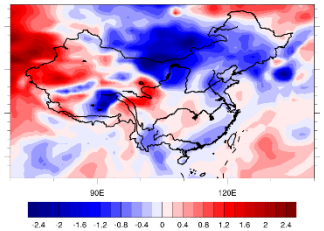
- **Outlook of China winter climate**

  Circulations, air temperature, precipitation, diagnoses

Effect verification of model forecasts on winter Temp during La Niña years

	1995/1996	1998/1999	1999/2000	2000/2001	2005/2006
OBS		 exception		 exception	
Models:					
BCC					
ECMWF					
CFSv2					

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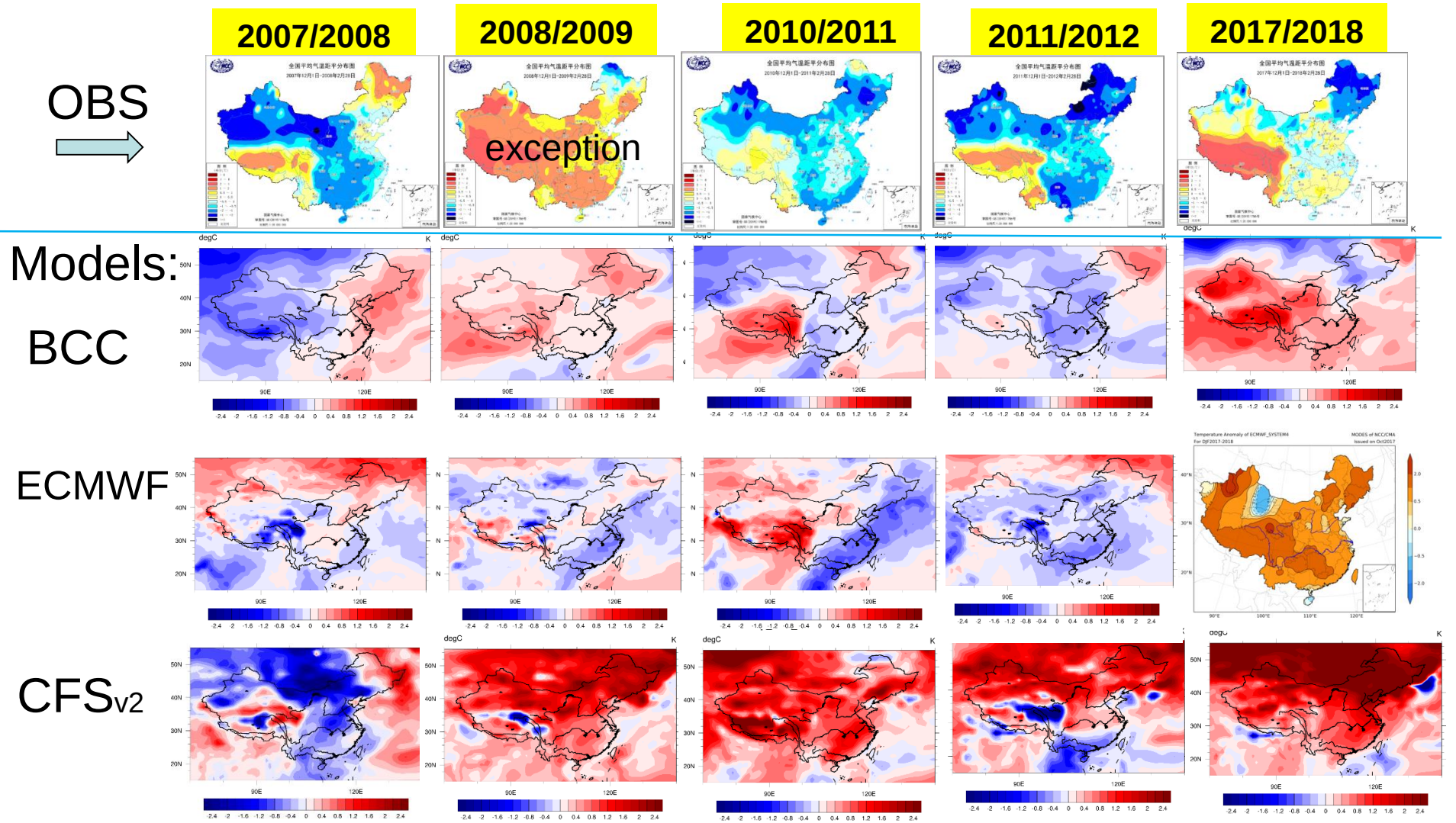
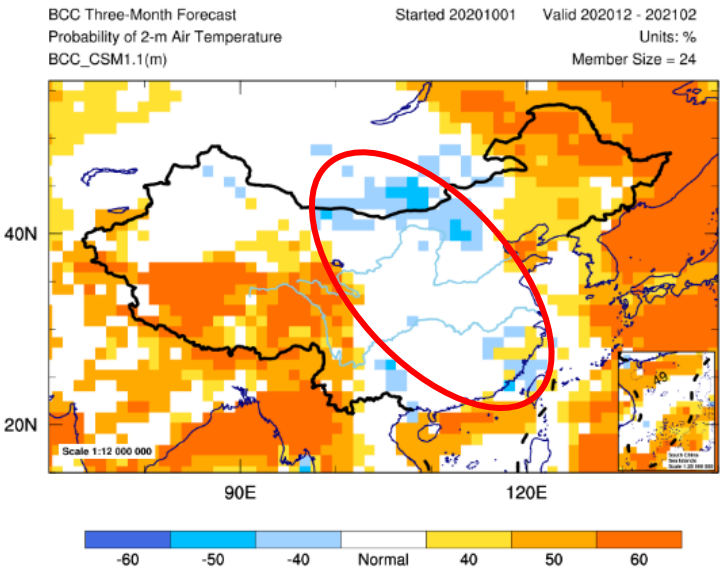


10 La Niña years since 1990，7 cold winters and 3 warm winters in OBS. Hit rates of BCC、EC、CFS in cold winters: 6/7，5/7,4/7,respectively, and in warm winters:3/3,1/3,2/3, respectively.

Winter Temp Forecasts for 2020/2021 by BCC Model

BCC_CSM1.1m



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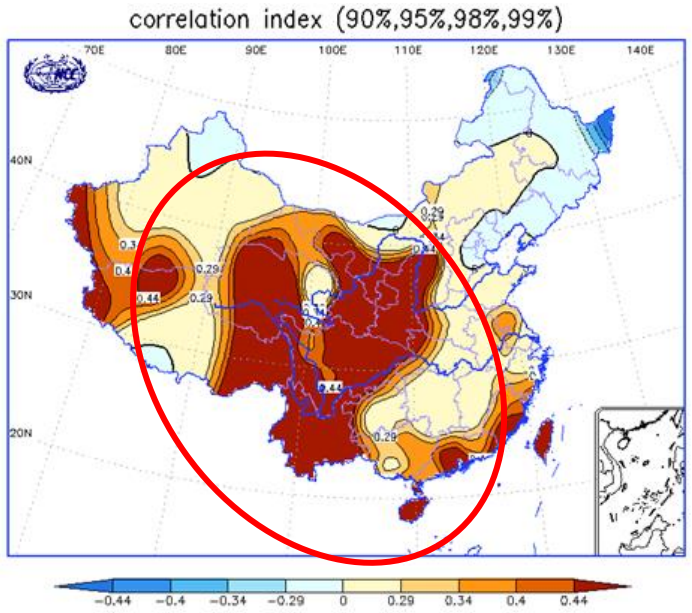
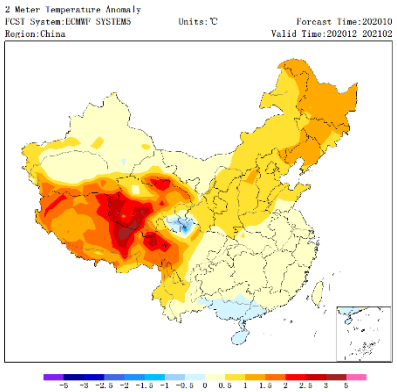


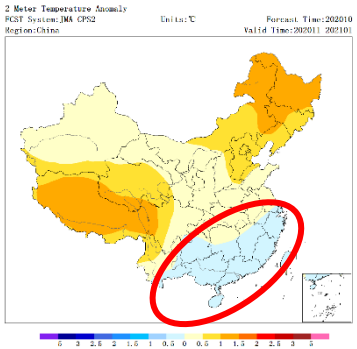
Lower Temp from Northwestern to southern China, with significant skills.

Winter Temp Forecasts for 2020/2021 by foreign Models

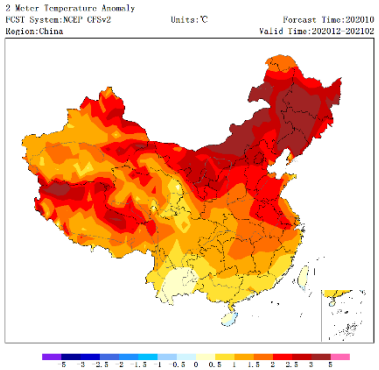
ECMWF5



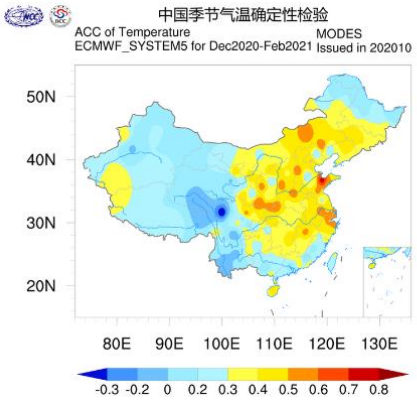
JMA Nov-Jan

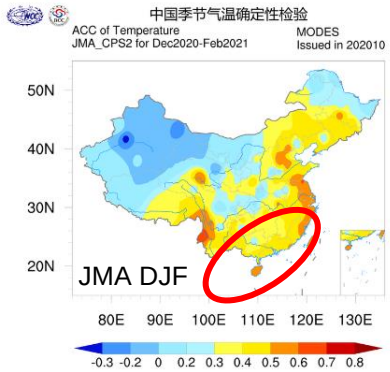


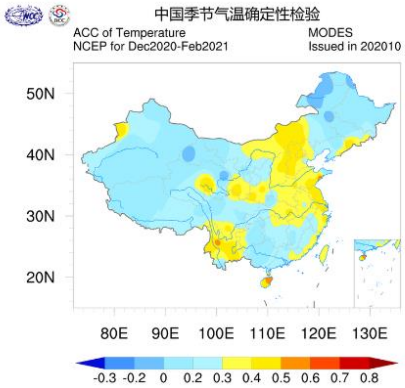
CFS V2



Validations

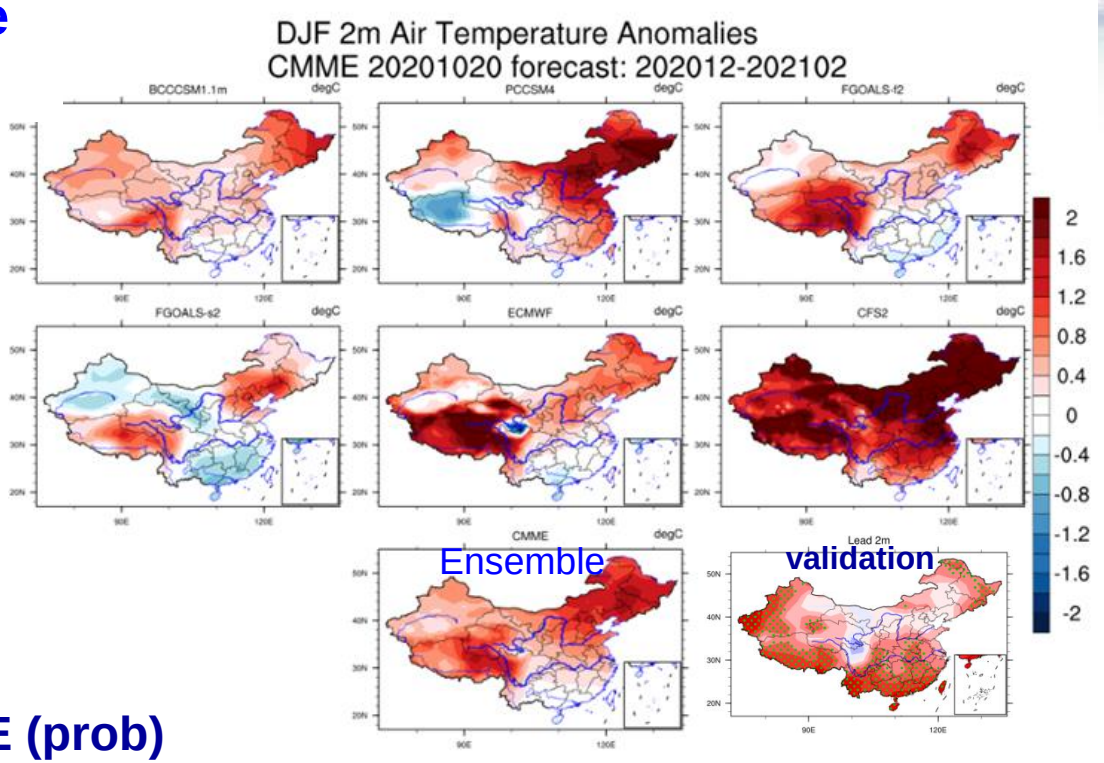






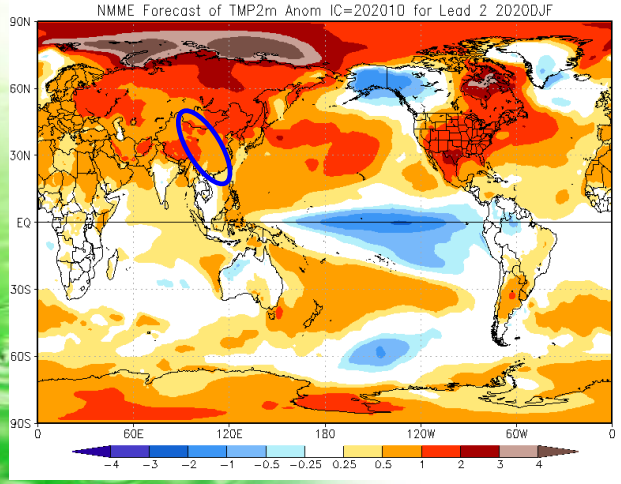
Multi-model Ensemble forecasts

CMME of BCC

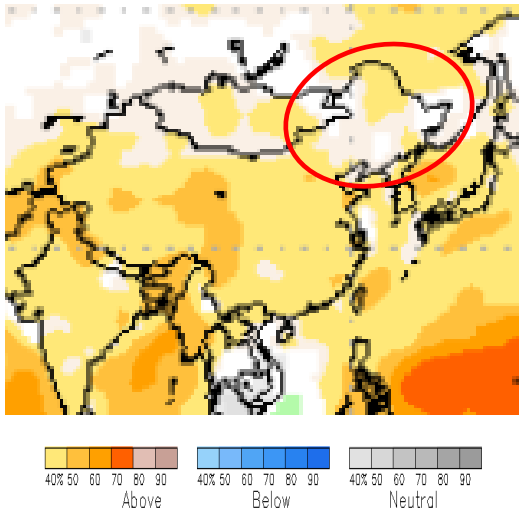


NMME (prob)

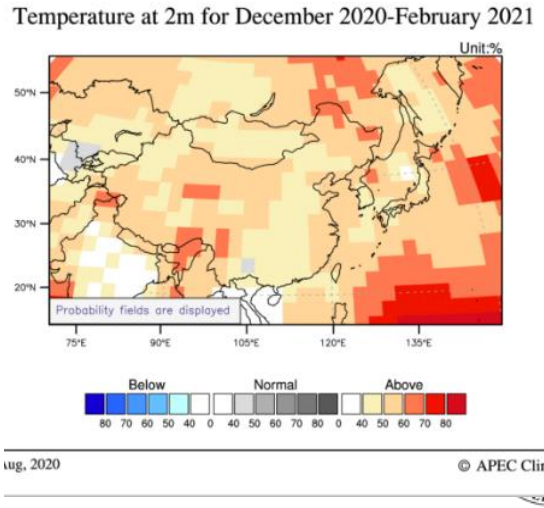
Issued in Oct2020



Issued in Sep2020



APCC



content

- **Recent characteristics of external forcings**

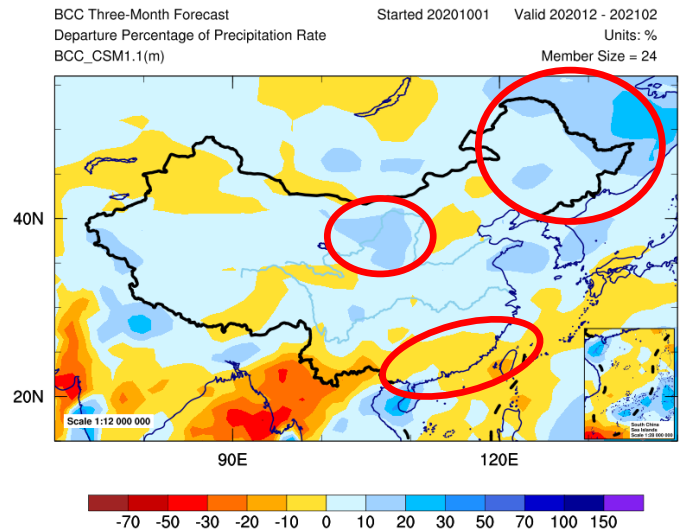
  Sea ice, SST

- **Outlook of China winter climate**

  Circulations, air temperature, precipitation, diagnoses

Winter Precipitation Forecasts for 2020/2021 by BCC Model

BCC_CSM1.1m



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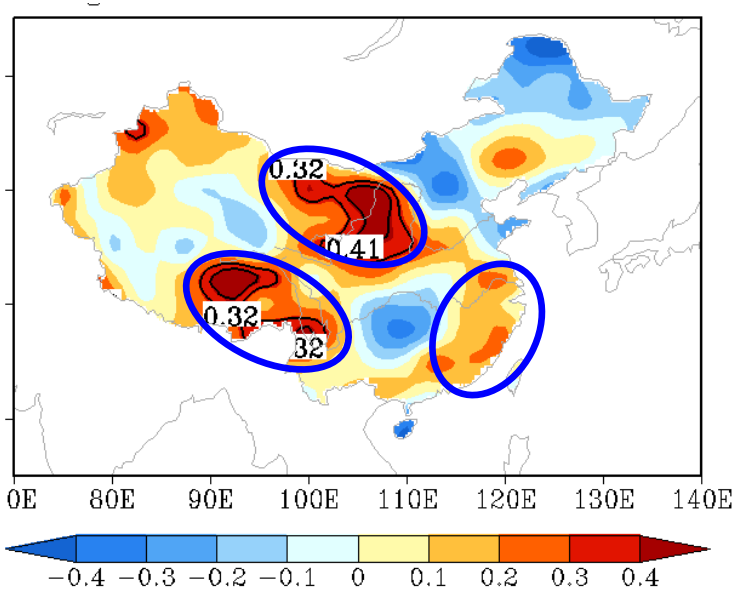
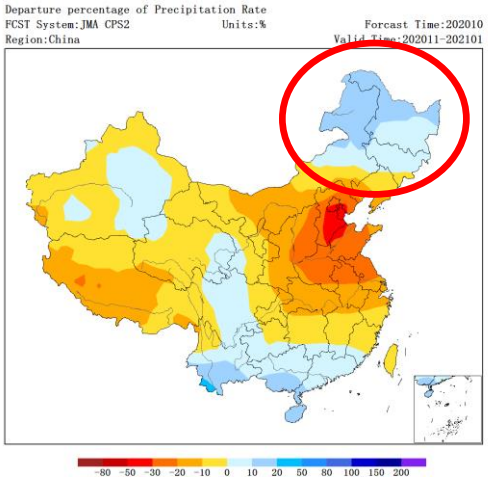


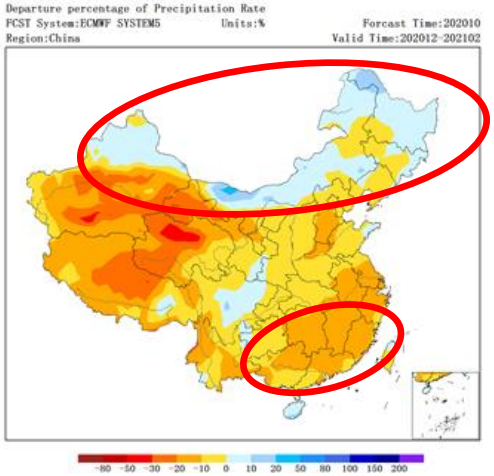
More precipitation in parts of Northwestern and Northeast China, while less precip in parts of southern China, most of them with significant skills.

Winter Precipitation Forecasts for 2020/2021 by foreign Models

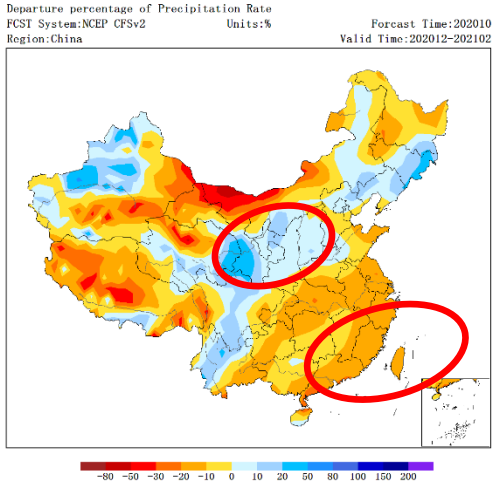
JMA Nov-Jan



ECMWF5



CFSv2



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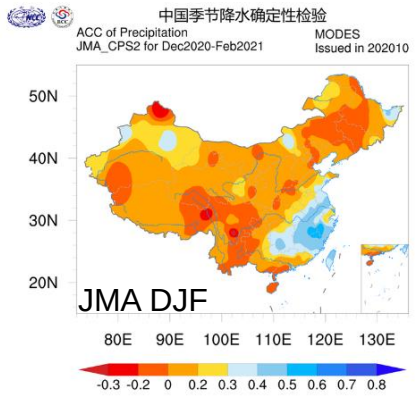
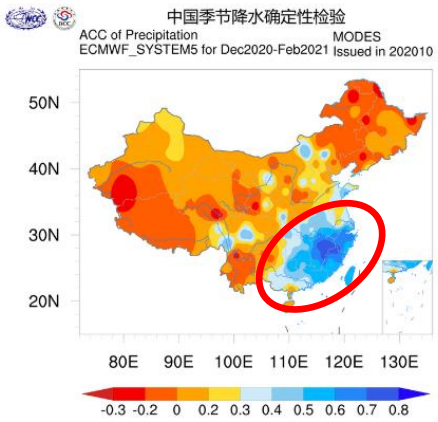
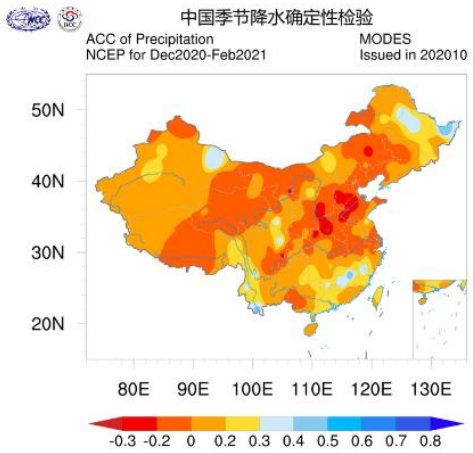
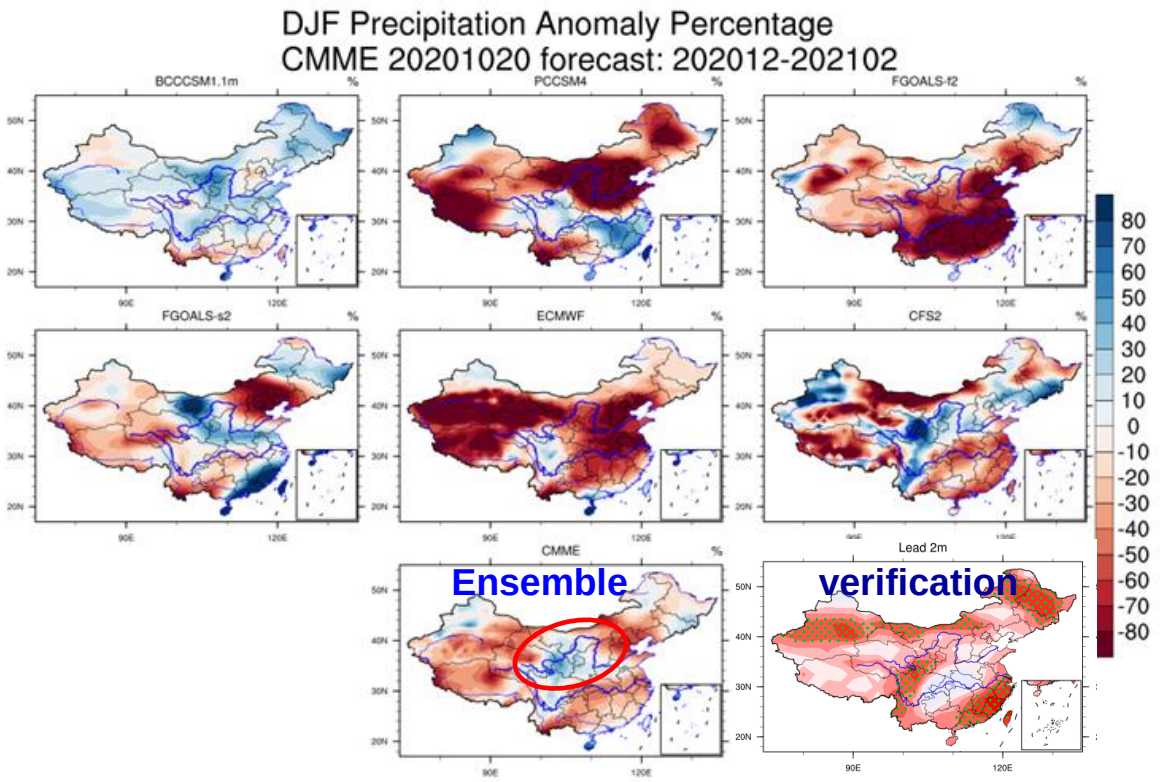




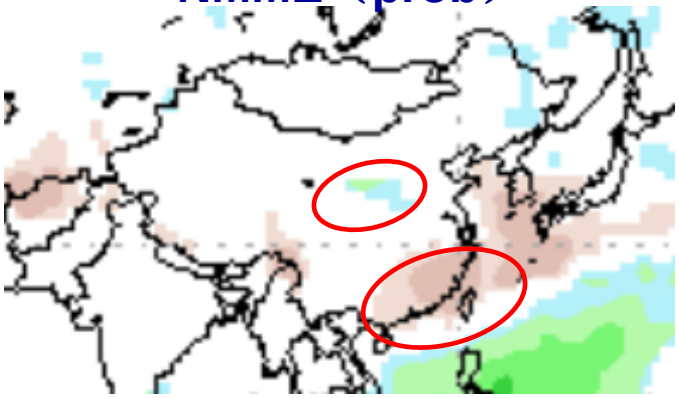


Multi-model Ensemble forecasts

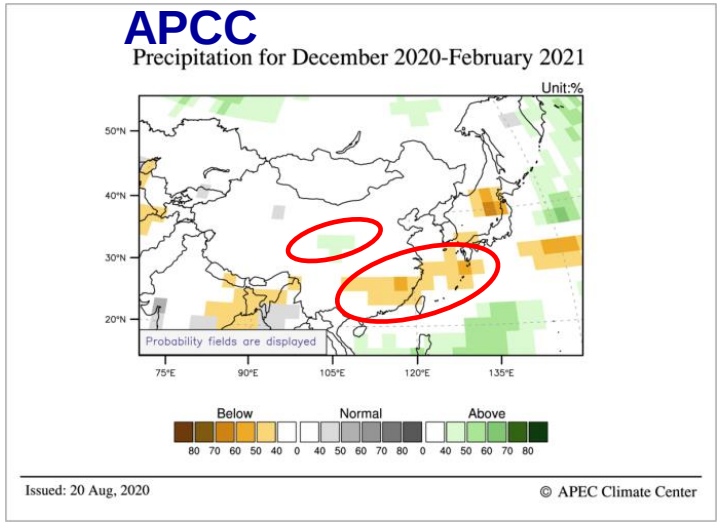
BCC CMME



NMME（prob）



APCC



content

- **Recent characteristics of external forcings**

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Summer Arctic dipole pattern(AD)

Pc1 and pc2 of Arctic thickness

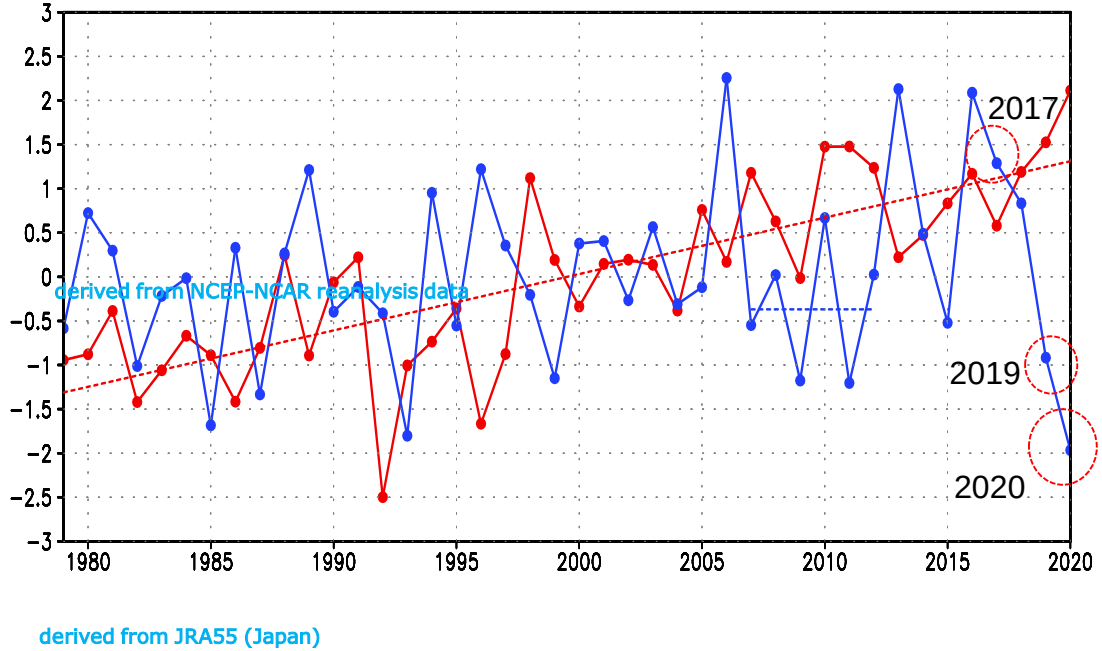


Figure 1. The first two principal components of summer (JJA) 1000–500-hPa thickness variability north of 30°N (normalized time series; red: PC1; blue: PC2), accounting for 30% and 10% of the variance. The red (blue) dashed line represents a linear trend in PC1 (mean of PC2 averaged over 2007–12).

The results derived from NCEP-NCAR reanalysis data show that PC2 was -2.0 in 2020.

AD pattern in negative phase

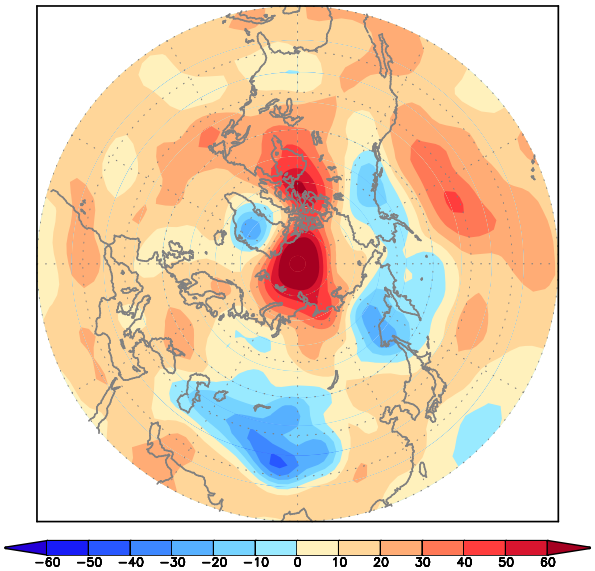


Figure 2. 1000-500 hPa thickness anomalies (gpm) in the summer (JJA) of 2020, relative to the summer mean averaged over the period from 1979 to 2019.

Bingyi Wu，2019；2016；2017

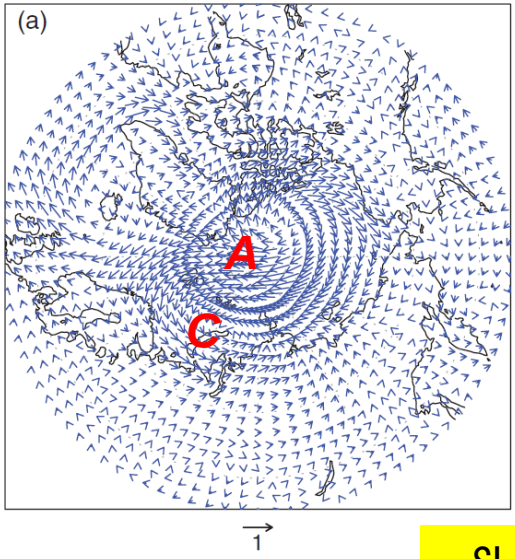
Impacts of Negative phase AD

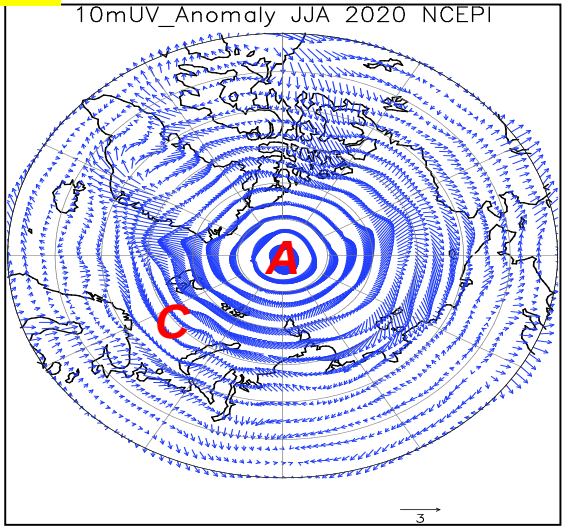
--under less Arctic Sea ice

Negative phase AD Pattern

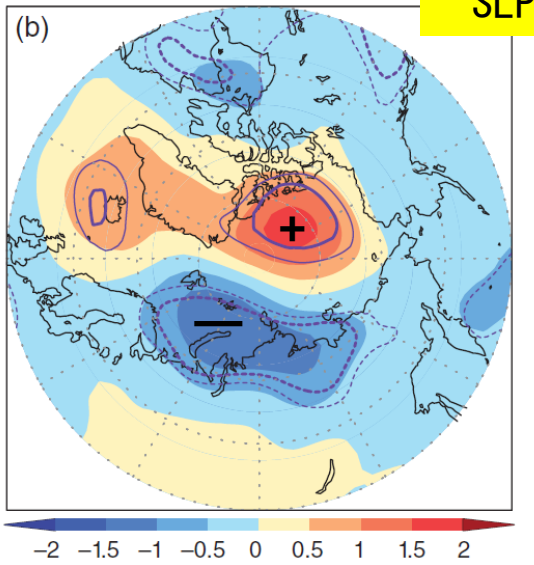
UV10m

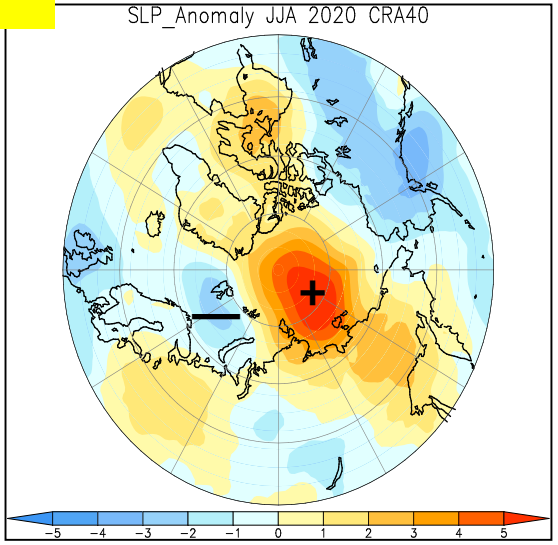
2020JJA



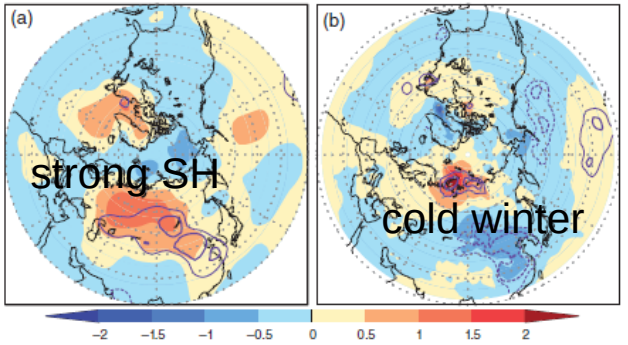


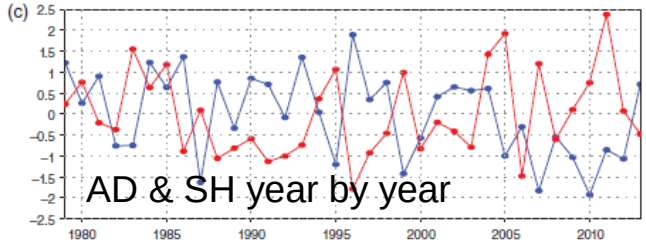
SLP

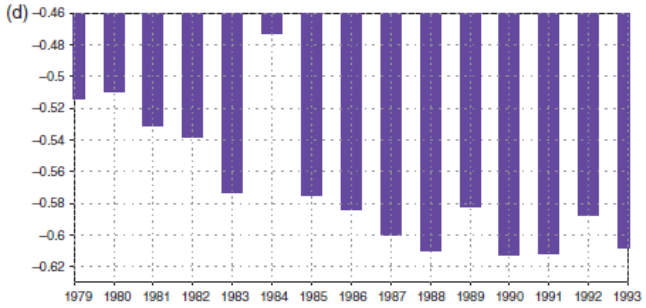




Impacts of -AD





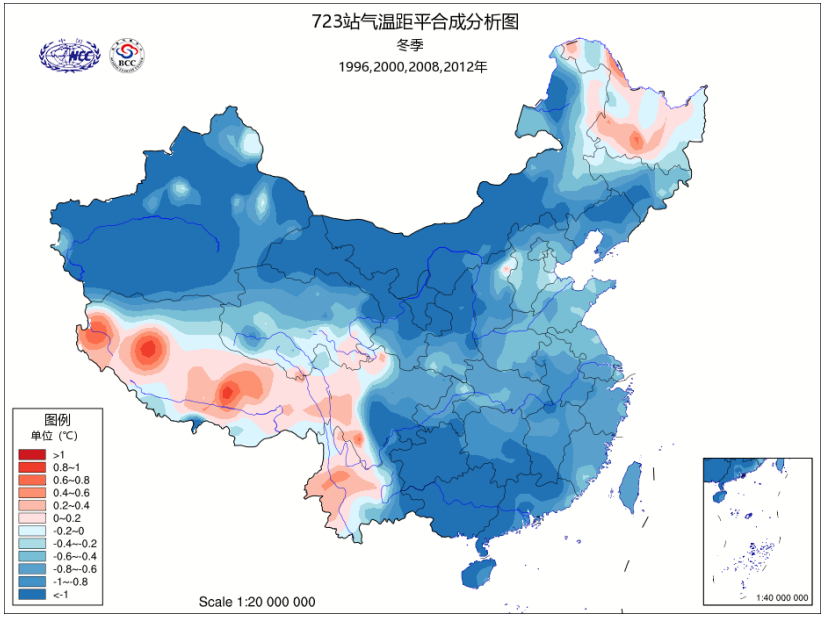


21-yr Running Corr between AD&SH

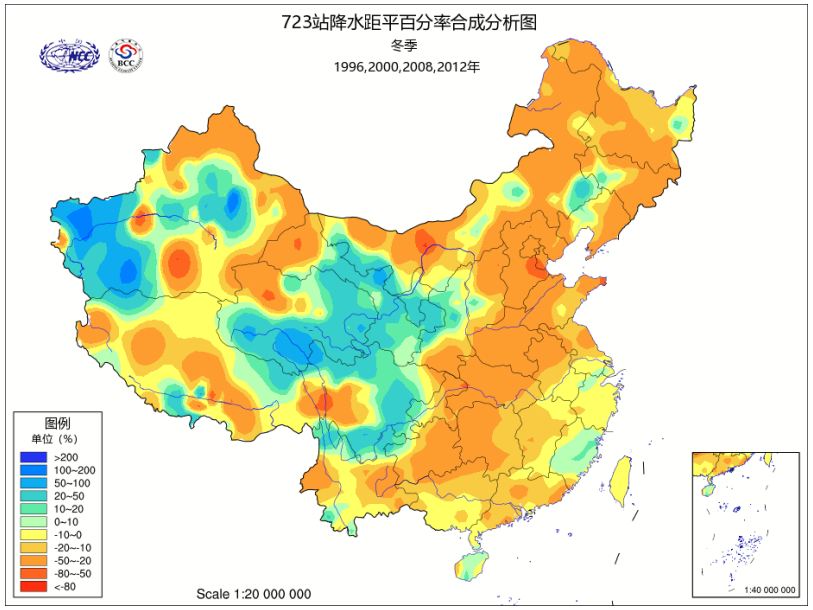
(Wu et al., 2016)

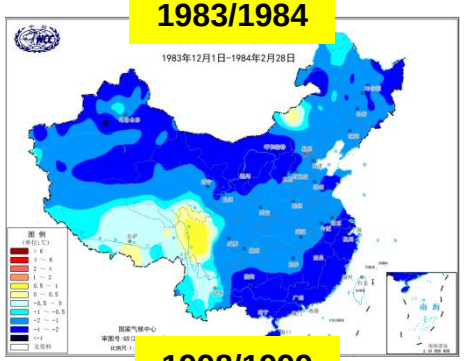
La Niña +less Arctic sea ice+negative AD

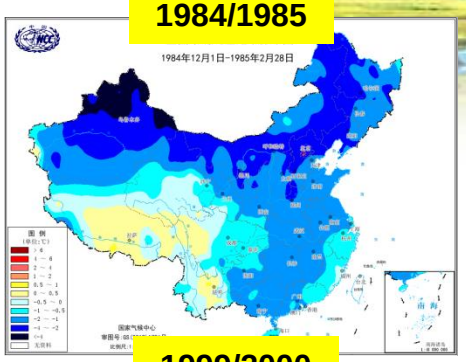
Composite of winter Temp

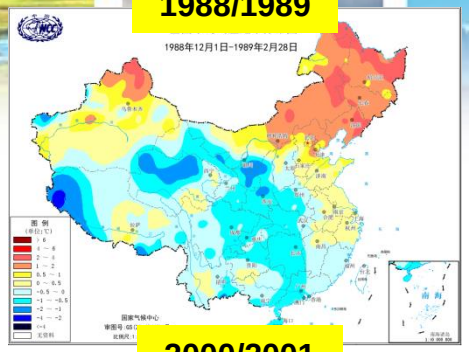


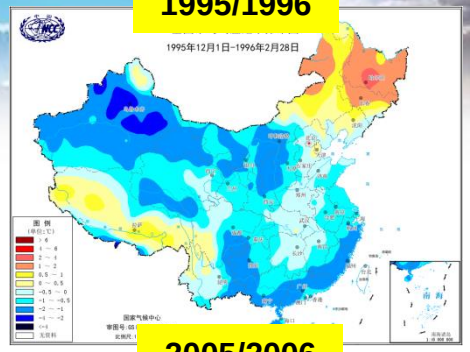
Composite of winter precip anomaly percentage

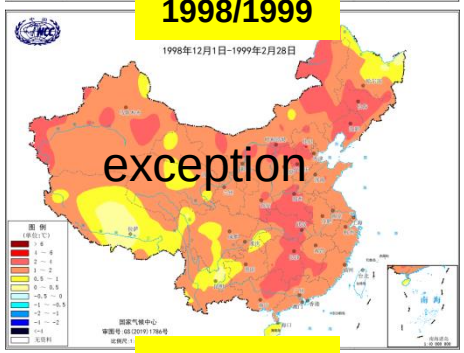


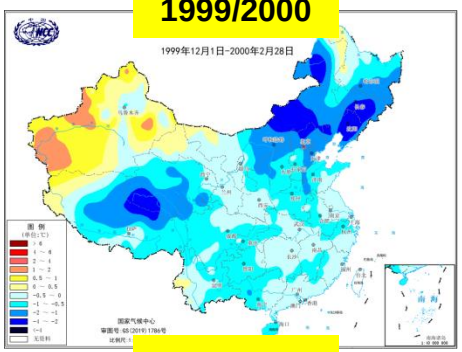


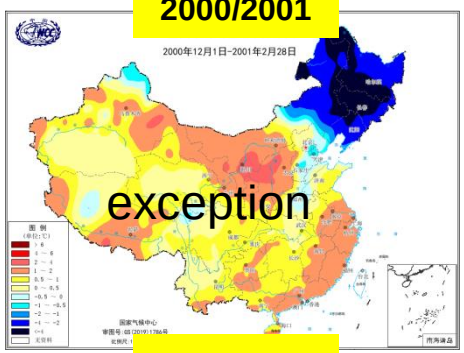


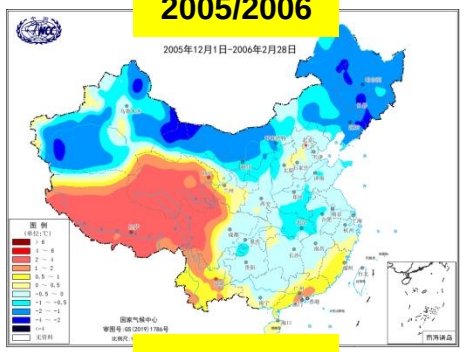


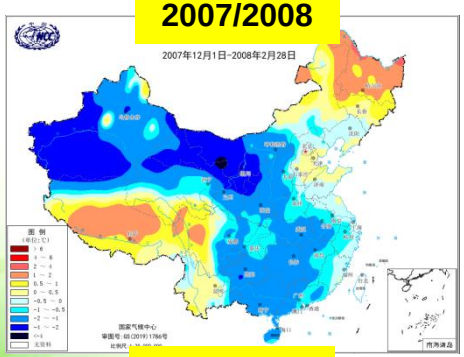


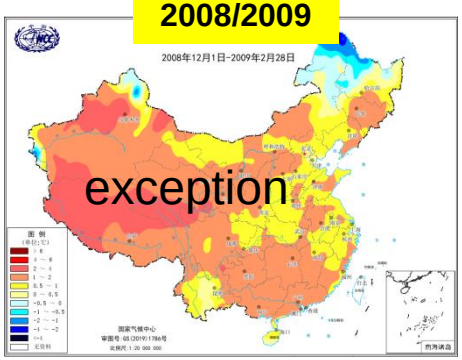


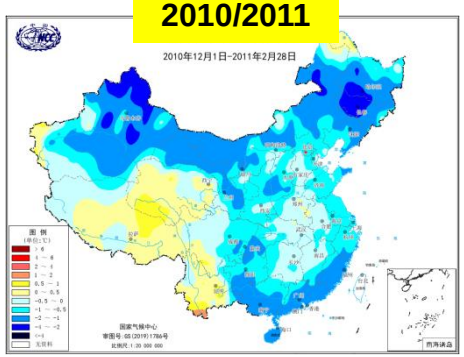


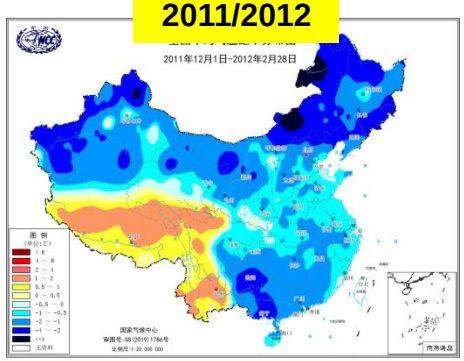


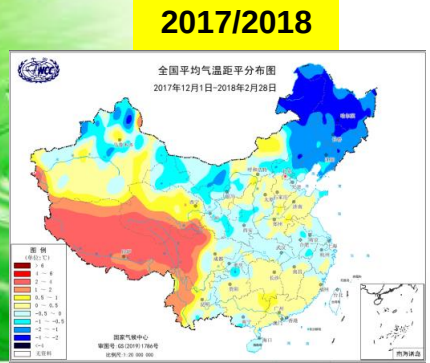












Temp anomalies of La Niña winters since 1981.

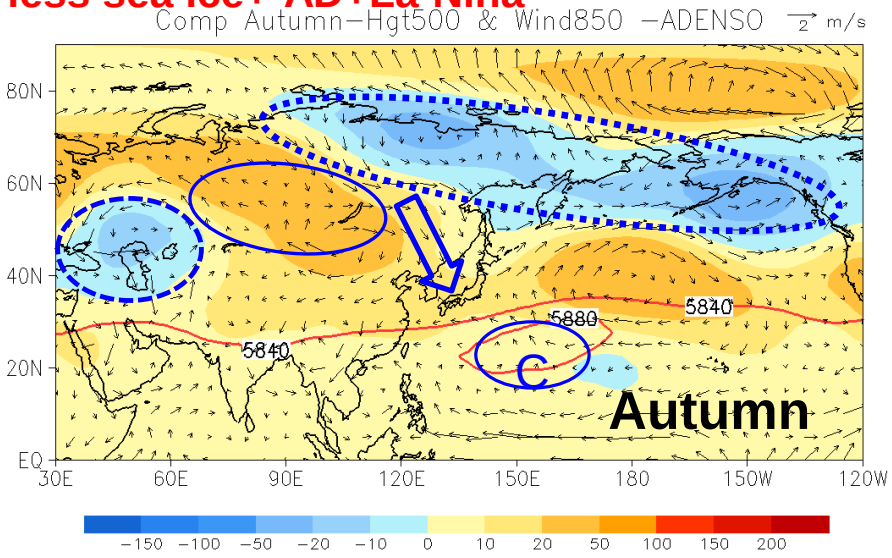
10 colder winters, only 3 warmer winters

exceptions:1998/1999,2000/2001,2008/2009

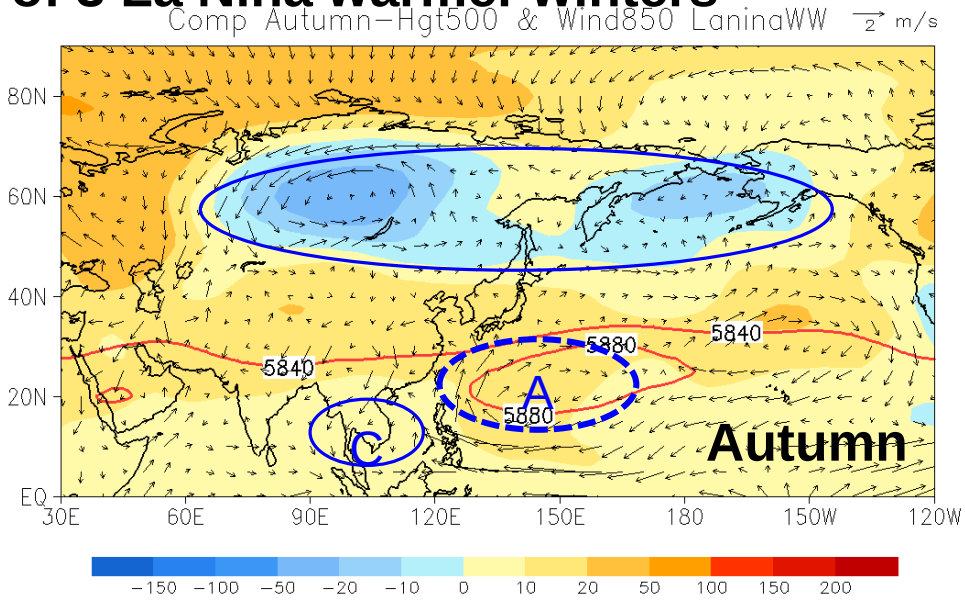
Preceding circulation of 3 warmer winters exceptions

Composite of previous circulation

less sea ice+-AD+La Niña

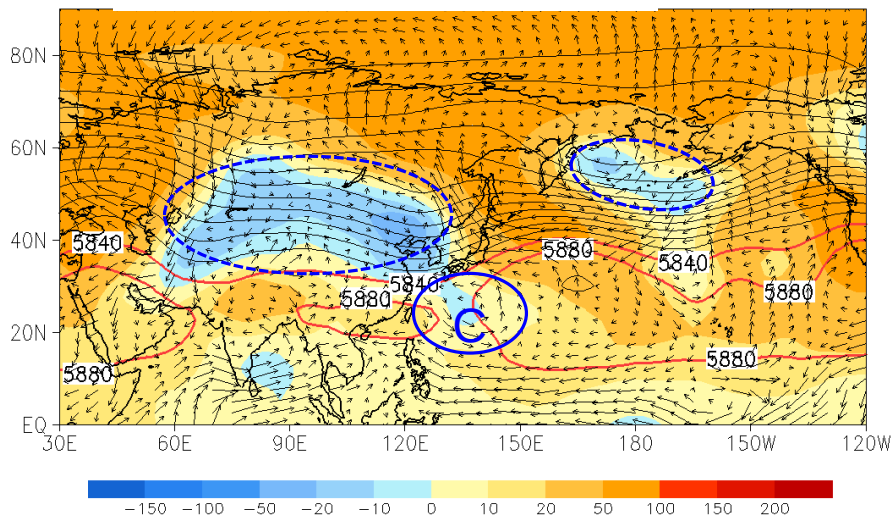


Composite of previous circulation of 3 La Niña warmer winters



Circ：500-hPa height 、anom、 850-hPa wind anomalies

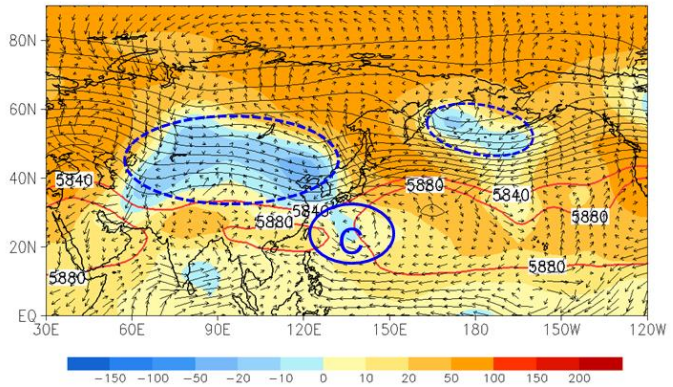
Circulation 01Sep-22Oct

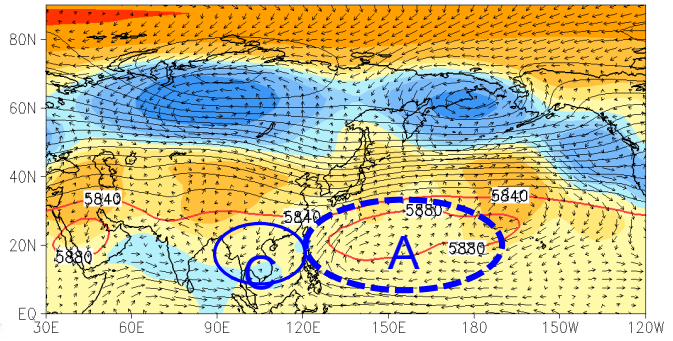


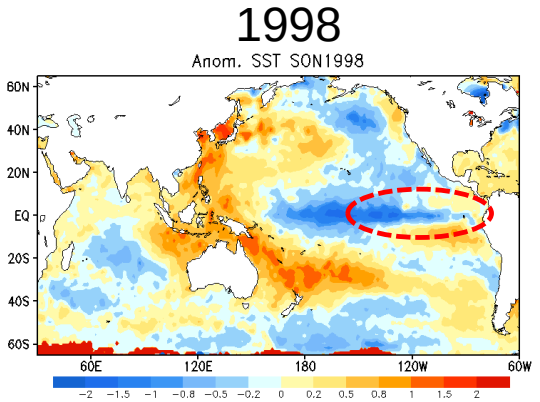
Autumn of Warmer winter: Philippine anticyclone anomaly;

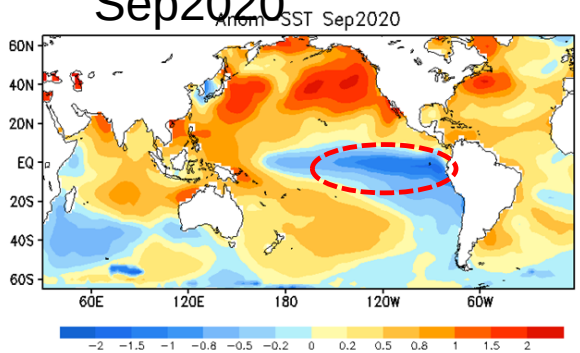
Current and colder winter: Philippine cyclone anomaly

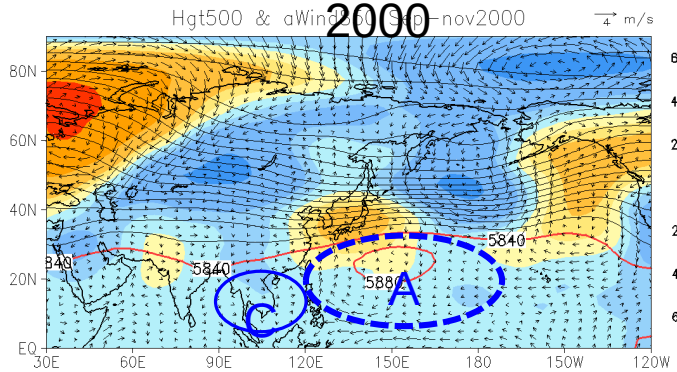
Comparison of Preceding climate with 3 warmer winters

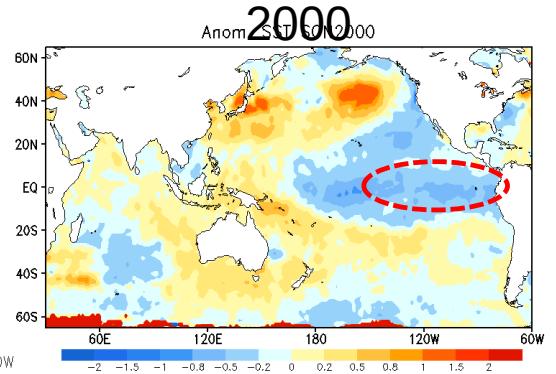


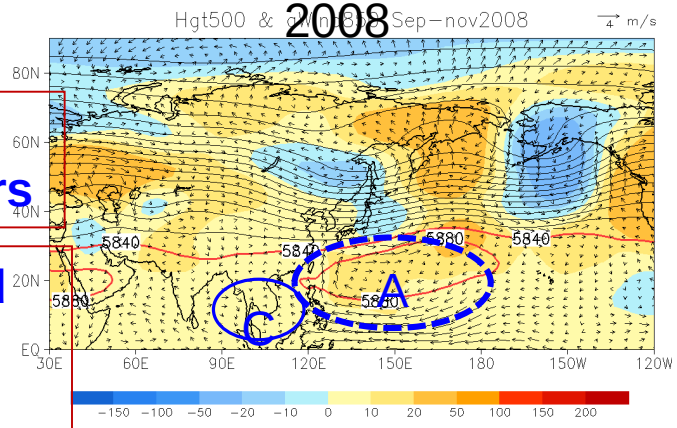


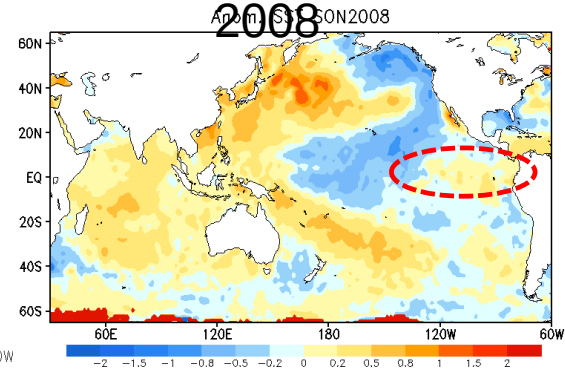










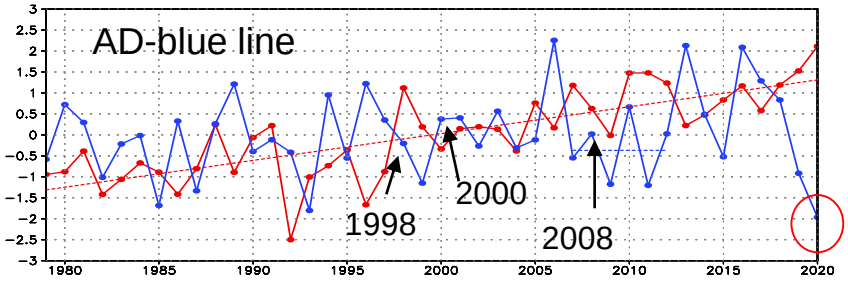


Circulation diff：Philippine anticyclone in warmer winters

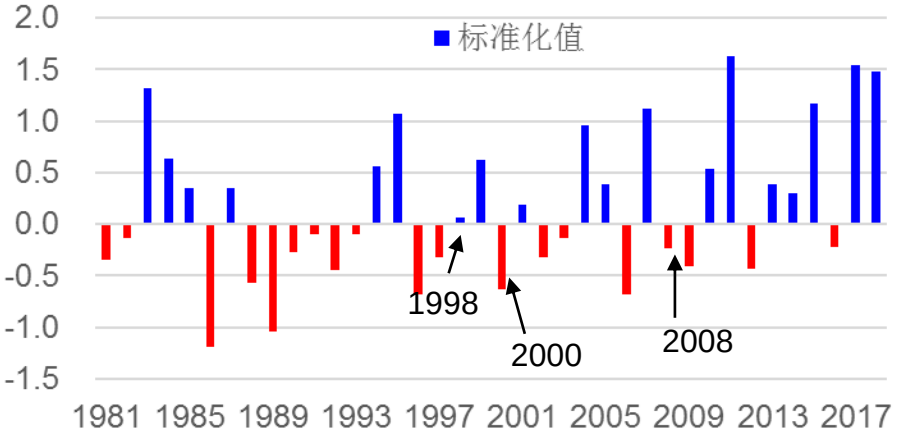
SST diff：westward SST cold center led an anticyclone response in warmer winters

Comparison of Preceding summer AD with 3 warmer winters

Pc1 and pc2 of Arctic thickness



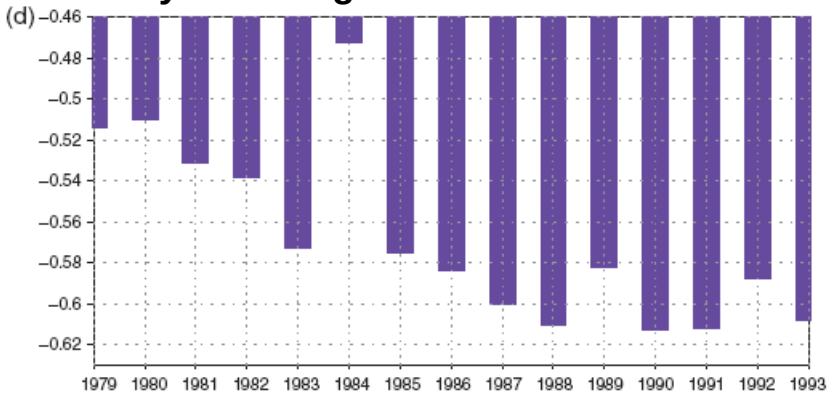
SH index standardized



3 La Nina warm winters all had higher AD values than that in colder La Nina winters. So following weak SH and warm winter；

The AD in 2020 is very low with -2.0, with considering less Arctic sea ice+La Niña， which are favorable to a colder winter. And warmer winter occurrence can be excluded.

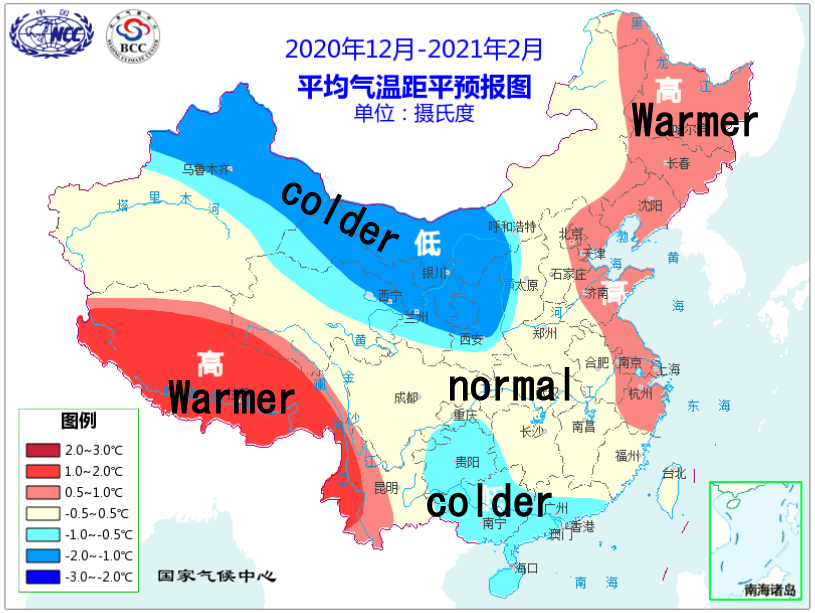
21-yr Running Corr between AD&SH



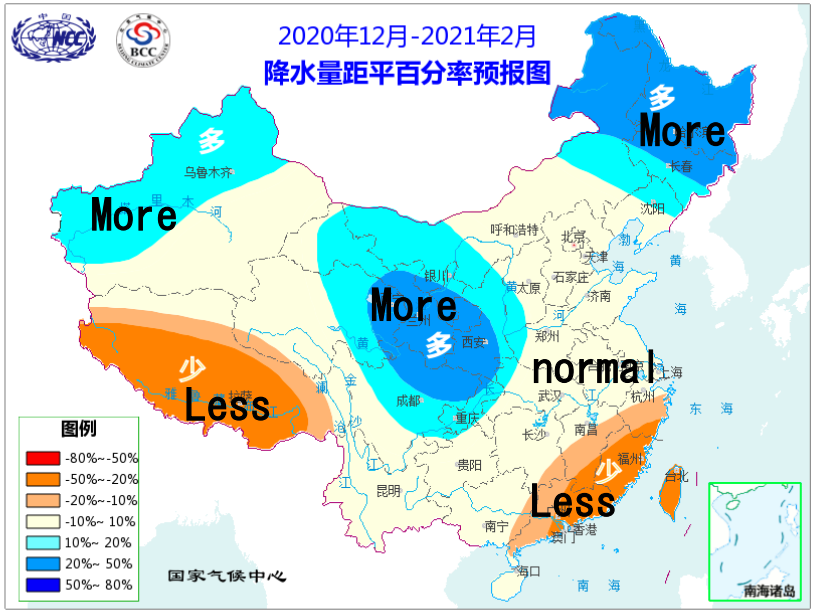
Bingyi Wu et al. 2016

Conclusion of China winter climate forecasting for 2020/2021

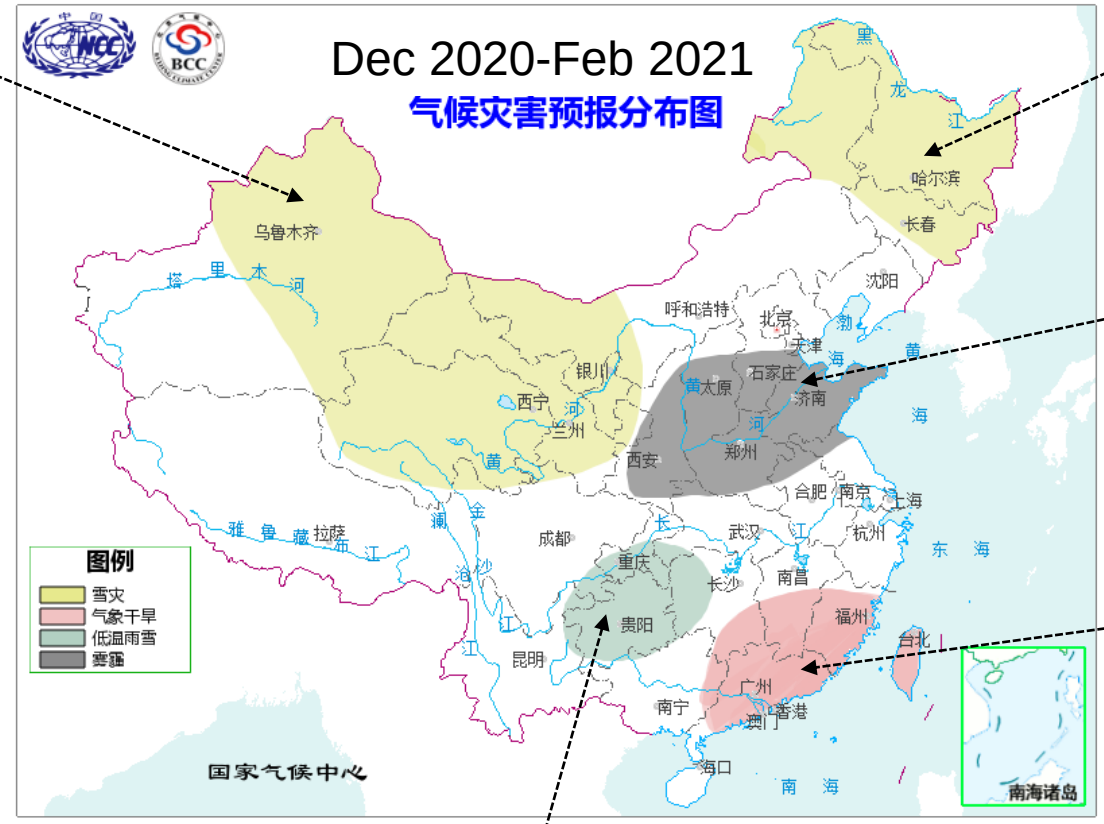
Anomalies of Air Temperature



Anomalous percentages of precipitation



Possible meteorological disasters in winter



Severe Snow

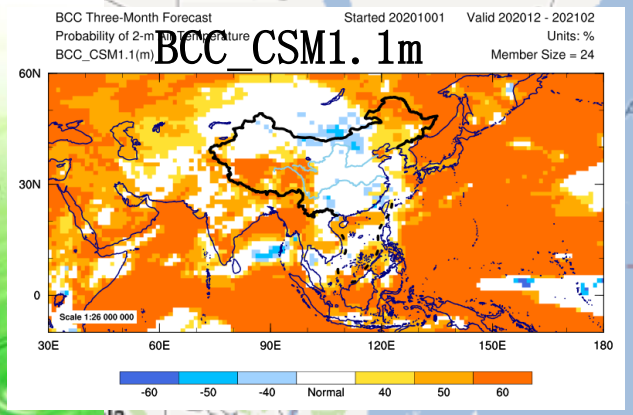
Severe Snow

Haze

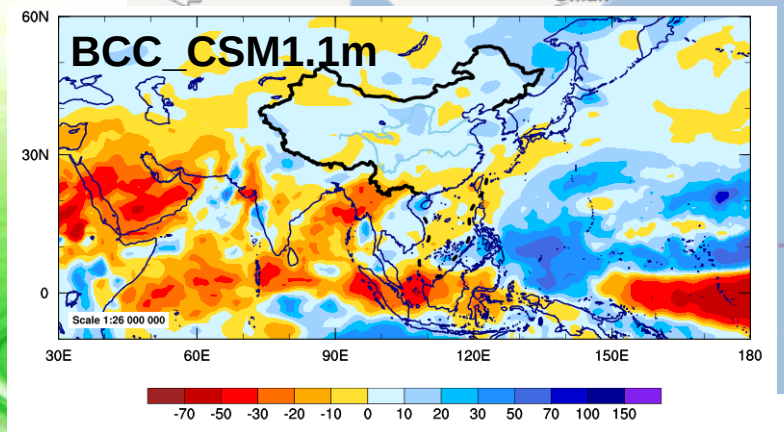
Meteorological drought

Low temperature & frozen

Outlook for Temp. in DJF 2020/2021



Outlook for Precip. in DJF 2020/2021



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South Korea
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Philippine Sea
East China Sea
South China Sea
Bay of Bengal
Andaman Sea
Laccadive Sea
Gulf of Thailand
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Thanks!

Welcome Comments!